MECHANICAL ENGINEERING

• AUGUST 1951 •

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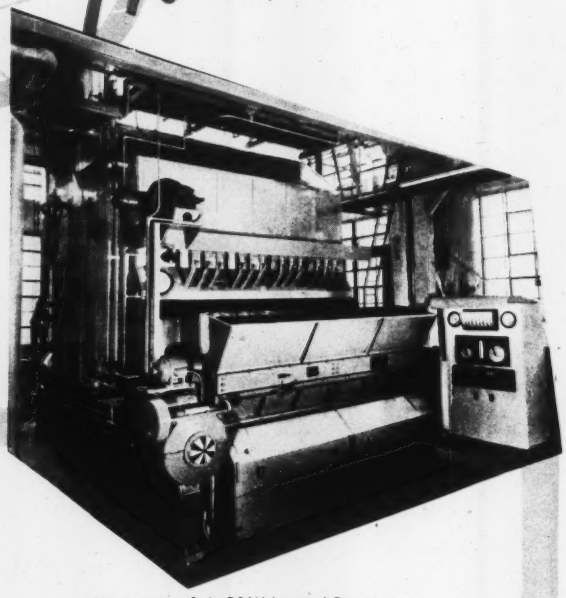
ASME FALL MEETING—Minneapolis, Minn., September 25-28, 1951

FALSTAFF® reduces costs... maintains *Premium Quality*

with B&W STEAM



Most recent of six B&W Integral-Furnace Boilers, installed in Falstaff breweries at St. Louis, Omaha and New Orleans.

Local unwashed Illinois coal is $1.10 a ton cheaper than the higher, washed grade formerly required by the Falstaff Breweries' natural draft stokers. When a new B&W Integral-Furnace Boiler, Type FF was installed in their St. Louis plant No. 5, Falstaff enjoyed an initial saving of 25% on fuel costs.

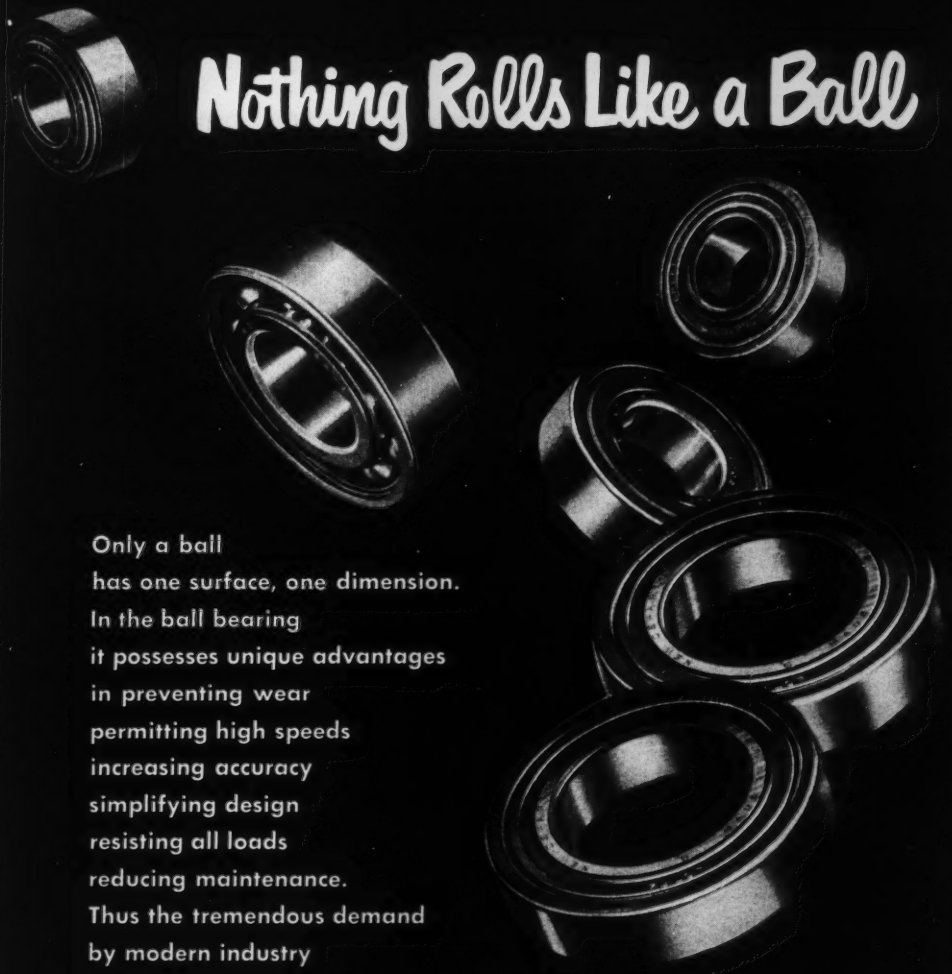
And that wasn't all . . . with the new B&W unit, they squeezed more efficiency from the cheaper fuel by increasing the rate of evaporation from 6.6 pounds of steam per pound of coal to 8.4 pounds . . . bringing fuel savings to a total of 45%!

Sudden load surges typical of brewery requirements are met with ease. Steam loads can be increased 15 to 20% within a matter of seconds without carryover or loss of pressure. Whatever your business, the use of B&W's 80 years' experience in boiler improvement is sure to be appreciated by your plant engineers and cost accountants. The Babcock & Wilcox Co., 85 Liberty St., New York 6, N.Y.

BABCOCK & WILCOX

G-526

Nothing Rolls Like a Ball



Only a ball
has one surface, one dimension.
In the ball bearing
it possesses unique advantages
in preventing wear
permitting high speeds
increasing accuracy
simplifying design
resisting all loads
reducing maintenance.
Thus the tremendous demand
by modern industry
for *ball* bearings
by New Departure.

Nothing Rolls Like a Ball...

NEW DEPARTURE

BALL BEARINGS

150

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, August, 1951, Vol. 73, No. 8. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Like to look at our mail?

We've got a letter here from the Bloch Brothers Tobacco Company of Wheeling, West Virginia. They tell us about a Centrifugal Refrigerating Machine of ours that was installed in 1931.

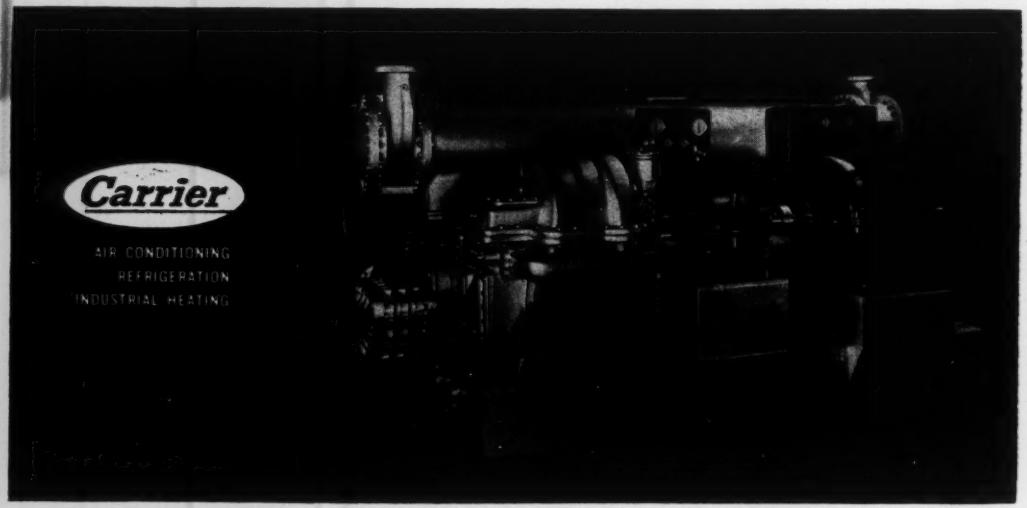
In 20 years, they say, they needed service just *once*. And that was a few years back when a bearing was replaced and the motor characteristics changed.

Other than that, the machine hasn't been touched!

But we get lots of letters like this. At Meadville, Pa., American Viscose Corporation has a Centrifugal that has been on the job for 24 hours a day since 1929. Whitman Chocolate of Philadelphia has one that we installed in 1924. And so on.

Our Centrifugal Machines economically get temperatures down to minus 150 degrees F. Ammonia, chlorine and other gases can be directly condensed. And reaction temperatures can be closely controlled.

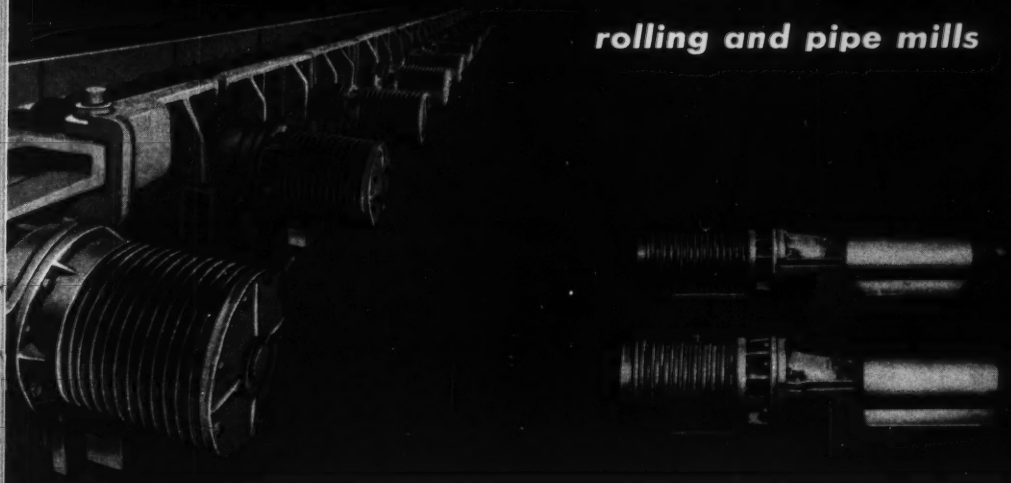
Write us for the whole convincing story about the Centrifugal. We'll show you how it can save you money on installation, operation and maintenance. Carrier Corporation, Syracuse 1, N. Y.



The self-contained Carrier Centrifugal Refrigerating Machine. Available in capacities from 100 to 1800 tons. Any type of motor or turbine drive is applicable.

powerful helper for

rolling and pipe mills



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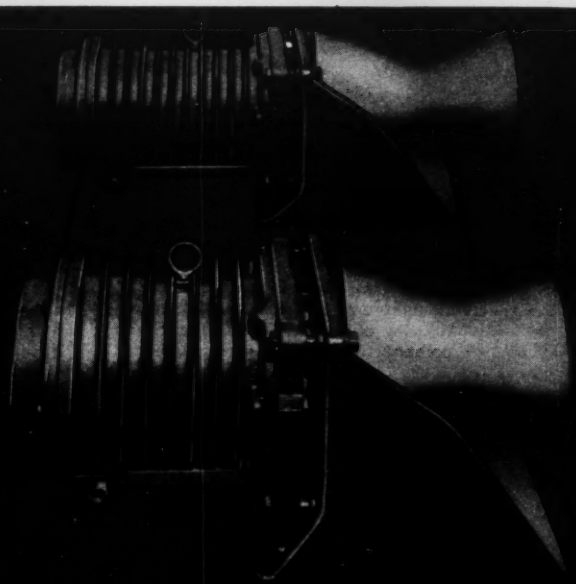
INDIVIDUALLY-DRIVEN MOTOR ROLLER UNITS

for heavy-duty service wherever Roller Tables are required

- AUTOMATIC SPEED CONTROL
- SPECIALLY DESIGNED LOEWY MOTOR
- LOW INERTIA ROTOR
- REDUCED OPERATING COSTS
- TABLE FORMS PERMIT FLEXIBLE ARRANGEMENT



LOEWY HYDROPRESS INC.

ROLLING MILLS AND ROLLING MILL EQUIPMENT

New Home of

BGR

Springs at Plymouth MICHIGAN

On and after September 1, 1951—our new plant, 40300 Plymouth Road, Plymouth, Michigan will take over the operations of our former Detroit Plant.

The ever-growing demand for our product has made necessary this move into larger quarters. On our new site of 50 acres, we have completed a modern one-story factory that will enable us to double the productive capacity of our old Detroit Plant, and consequently increase to a greater extent our service to customers.

After Sept. 1, please direct all correspondence to:

Barnes-Gibson-Raymond Division
Associated Spring Corporation
P. O. Box No. 555, Plymouth, Michigan

Business continues as usual at Cook Plant of B-G-R at Ann Arbor, Michigan

This move in no way affects the operation of our Cook Plant, Ann Arbor, Michigan which will continue the same as in the past.

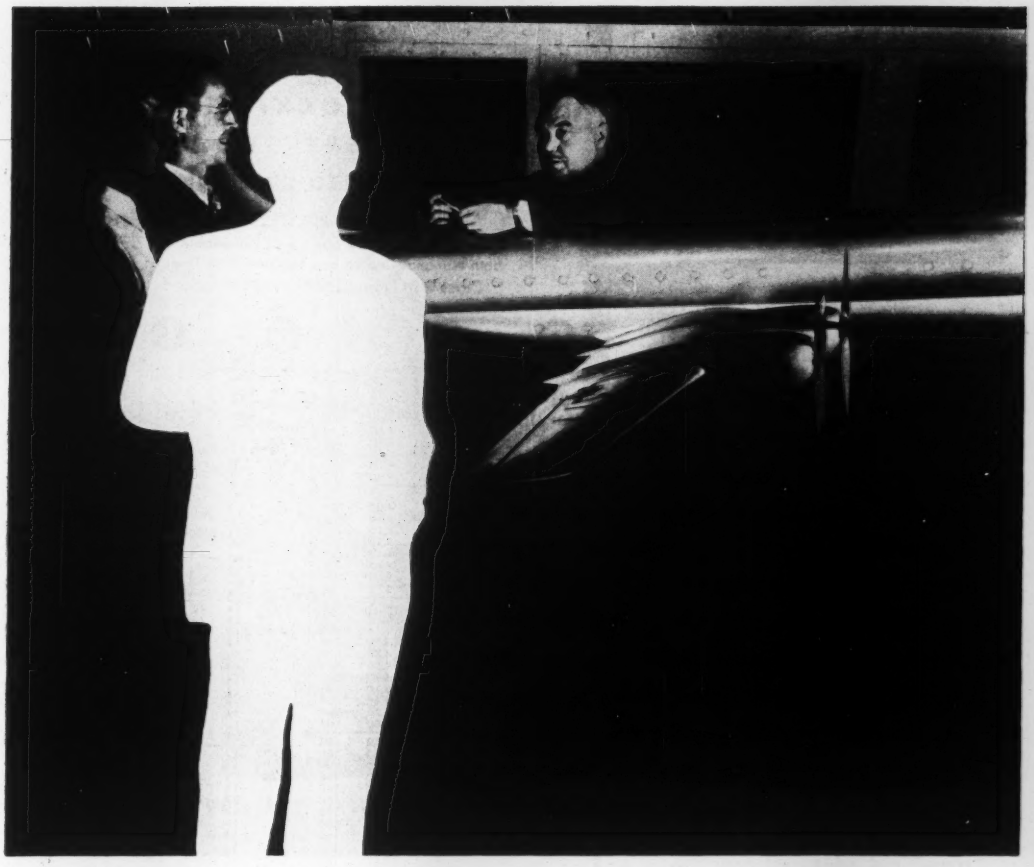
BARNES - GIBSON - RAYMOND

DIVISION OF ASSOCIATED SPRING CORPORATION

40300 Plymouth Road
Plymouth, Michigan
Tel. 2310

2 plants for SPRING SERVICE

Cook Plant • 401 E. Stadium Blvd.
Ann Arbor, Michigan
Tel. 3-4258



Do you fit in the Boeing picture?

Boeing's world-wide reputation for sound engineering achievement is founded on *men*. Boeing engineers and physicists are graduates of many universities and technical schools. They come from every state in the Union. Under inspiring leadership they have been welded into one of the most potent forces in any field of scientific advance.

If you can measure up to Boeing standards, there is an attractive future for you in this renowned group. In addition to the prestige which attaches to being a member of the Boeing engineering team, there are other definite advantages:

1 The challenge of working on such vital programs as the B-47 and B-52 jet bombers, guided missiles and other revolutionary developments.

2 Stability of career opportunity with an engineering division that is still growing steadily after 35 years.

3 The invigorating atmosphere of the Pacific Northwest—hunting, fishing, sailing, skiing, temperate climate all year around.

4 The availability of housing. Newcomers to Seattle are able to get accommodations—and that's unique in a great aircraft manufacturing center.

5 Good salaries. And they grow with you.

6 Moving and travel expense allowance.

Boeing's immediate needs call for experienced and junior aeronautical, mechanical, electrical, electronics, civil, acoustical and weights engineers for design and research; for servo-mechanism designers and analysts; and for physicists and mathematicians with advanced degrees.

Write today to the address below or use the convenient coupon.

JOHN C. SANDERS, Staff Engineer—Personnel
DEPT. M-8
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

BOEING

"STANDARD" recommends STANDARDS*

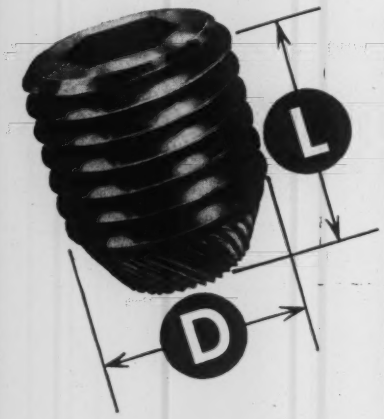
UNBRAKO®

SELF-LOCKING SOCKET SET SCREWS (WITH KNURLED CUP POINT)

STANDARD SIZES

Sizes preceded by asterisk (*) available in both National Coarse and National Fine Threads

Class 3 fit is an "UNBRAKO" standard



The unique, counter-clockwise *knurls* on the UNBRAKO Cup Point make these screws *self-locking*, prevent "creep" and subsequent loosening. And, UNBRAKO Set Screws with the Knurled Cup Point "stay put" even in poorly tapped holes — an important factor in reducing machinery stoppage and production losses.

★ One of a series listing *Standard* UNBRAKO Socket Screw Products sold by your local UNBRAKO Distributor. If you want reprints of this and other advertisements in the series, ask for them on your business letterhead.

D Diameter	Threads per inch NC	Threads per inch NF	L Overall Length	Price per 100	Quantity per box
#4 (.112")	40	48	* 1/8	3.95	100
	40	48	* 3/16	4.00	100
	40	48	* 1/4	4.05	100
	40	48	* 5/16	4.10	100
	40	48	* 3/8	4.20	100
	40		7/16	4.40	100
	40		1/2	4.70	100
	40		5/8	5.00	100
#5 (.125")	40	44	* 1/8	4.00	100
	40	44	* 3/16	4.05	100
	40	44	* 1/4	4.10	100
	40		5/16	4.15	100
	40		3/8	4.25	100
	40		7/16	4.45	100
	40		1/2	4.75	100
	40		5/8	5.05	100
	40		3/4	5.35	100
#6 (.138")	32	40	* 1/8	4.05	100
	32	40	* 3/16	4.10	100
	32	40	* 1/4	4.15	100
	32	40	* 5/16	4.20	100
	32	40	* 3/8	4.30	100
	32		7/16	4.50	100
	32		1/2	4.80	100
	32		5/8	5.10	100
	32		3/4	5.40	100
	32		7/8	5.70	100
	32		1	6.00	100
#8 (.164")	32	36	* 1/8	4.10	100
	32	36	* 3/16	4.15	100
	32	36	* 1/4	4.20	100
	32	36	* 5/16	4.25	100
	32	36	* 3/8	4.35	100
	32		7/16	4.55	100
	32	36	* 1/2	4.85	100
	32		9/16	5.15	100
	32		5/8	5.45	100
	32		3/4	5.75	100
	32		1	6.05	100
#10 (.190")	24	32	* 3/16	4.20	100
	24	32	* 1/4	4.25	100
	24	32	* 5/16	4.30	100
	24	32	* 3/8	4.40	100
	24	32	* 7/16	4.60	100
	24	32	* 1/2	4.90	100
	24	32	* 5/8	5.20	100
	24	32	* 3/4	5.50	100
	24		7/8	5.80	100
	24	32	*1	6.10	100
	24	32	*1 1/4	6.65	100
1/4 (.250")	20	28	* 3/16	4.30	100
	20	28	* 1/4	4.35	100
	20	28	* 5/16	4.40	100
	20	28	* 3/8	4.50	100
	20	28	* 7/16	4.70	100
	20	28	* 1/2	5.00	100
	20	28	* 5/8	5.35	100
	20	28	* 3/4	5.70	100
	20		7/8	6.05	100
	20	28	*1	6.40	100
	20	28	*1 1/4	7.10	100
	20		1 1/2	7.80	100
	20		1 3/4	8.50	100
	20		2	9.70	100
5/16 (.3125")	18	24	* 1/4	4.45	100
	18	24	* 5/16	4.50	100
	18	24	* 3/8	4.60	100
	18	24	* 7/16	4.80	100
	18	24	* 1/2	5.10	100
	18	24	* 5/8	5.50	100
	18	24	* 3/4	6.00	100
	18		7/8	6.50	100
	18	24	*1	7.00	100
	18	24	*1 1/4	7.60	100

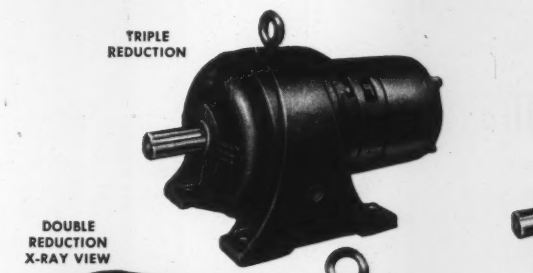
D Diameter	Threads per inch NC	Threads per inch NF	L Overall Length	Price per 100	Quantity per box
5/16 (.3125")	18		1 1/2	8.40	100
	18		1 3/4	9.20	100
	18		2	10.50	100
3/8 (.375")	16	24	* 1/4	4.55	100
	16	24	* 5/16	4.60	100
	16	24	* 3/8	4.70	100
	16	24	* 7/16	4.90	100
	16	24	* 1/2	5.20	100
	16	24	* 5/8	5.60	100
	16	24	* 3/4	6.20	100
	16		7/8	6.80	100
	16	24	*1	7.40	100
	16	24	*1 1/4	8.20	100
	16		1 1/2	9.20	100
	16		1 3/4	10.50	100
	16		2	12.50	100
	16		2 1/2	14.50	100
7/16 (.4375")	14	20	* 3/8	5.90	100
	14	20	* 7/16	6.10	100
	14	20	* 1/2	6.40	100
	14		5/8	6.80	100
	14		3/4	7.40	100
	14		7/8	8.00	100
	14		1	8.70	100
	14		1 1/4	9.50	100
	14		1 1/2	11.00	100
	14		1 3/4	12.50	100
	14		2	14.00	50
	14		2 1/2	16.50	50
1/2 (.500")	13		3/8	6.90	100
	13		7/16	7.10	100
	13	20	* 1/2	7.40	100
	13	20	* 5/8	7.80	100
	13	20	* 3/4	8.40	100
	13		7/8	9.00	100
	13	20	*1	9.70	100
	13		1 1/4	10.50	100
	13		1 1/2	12.00	100
	13		1 3/4	13.50	50
	13		2	15.00	50
	13		2 1/2	17.50	50
	13		3	20.00	50
5/8 (.625")	11		1/2	9.90	100
	11	18	* 5/8	10.30	50
	11		3/4	10.90	50
	11		7/8	11.50	50
	11	18	*1	12.50	50
	11		1 1/4	13.50	50
	11		1 1/2	14.50	50
3/4 (.750")	10		5/8	12.80	50
	10		3/4	13.40	50
	10		7/8	14.00	50
	10		1	15.00	50
	10		1 1/4	16.00	50
	10		1 1/2	18.00	50
	10		1 3/4	20.00	50
	10		2	23.00	25
	10		2 1/2	27.00	25
	10		3	31.00	25
7/8 (.875")	9		7/8	17.00	25
	9		1	18.00	25
	9		1 1/4	20.00	25
	9		1 1/2	22.00	25
	9		1 3/4	25.00	25
	9		2	29.00	25
	9		2 1/2	34.00	25
	9		3	39.00	25
1 (1.000")	8		1	23.00	25
	8		1 1/4	25.00	25
	8		1 1/2	28.00	25
	8		1 3/4	32.00	25
	8		2	36.00	25
	8		2 1/2	42.00	25
	8		3	48.00	25

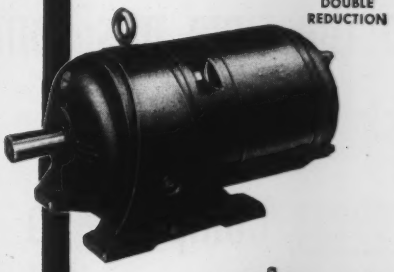
Prices subject to change without notice.

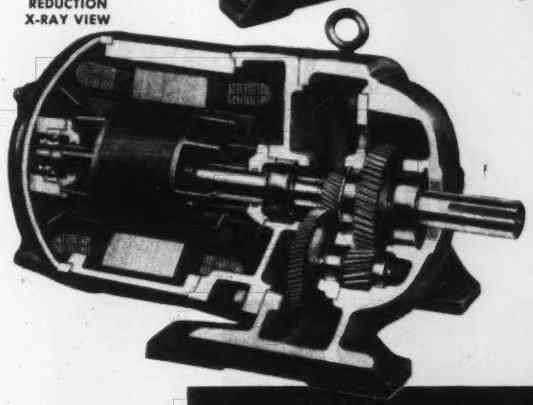
LIST PRICES SUBJECT TO DISCOUNT

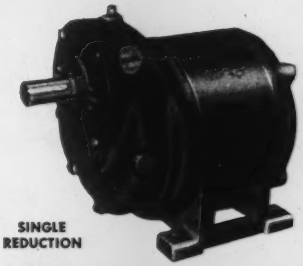
Most tapped holes are *standard*, why specify "special" screws? Use UNBRAKO *standards!*

SPS









FOOTE BROS.–LOUIS ALLIS GEARMOTORS

PROMPT DELIVERY!

Would prompt delivery of Gearmotors solve your problem?

If you're up against costly delay, then keep in mind that you can count on prompt delivery of Foote Bros.-Louis Allis Gearmotors.

Foote Bros. offer the finest Gearmotor obtainable. A Gearmotor of superior design and construction—produced jointly by Foote Bros. and Louis Allis—both leaders in their respective fields.

Foote Bros.-Louis Allis Gearmotors are available in single, double and triple reductions to provide output speeds of 780 down to 7.5 r.p.m. Capacities from 1 h.p. through 150 h.p. Open drip-proof, splash-proof, enclosed and explosion-proof motors.

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GEAR AND MACHINE CORPORATION
Dept Q, 4545 South Western Blvd., Chicago 9, Ill.

- **Duti-Rated Gears—file hard tooth surfaces—resilient cores.**
- **Tang driven motor shaft pinion positively positioned.**
- **Extra capacity ball or tapered roller bearings.**
- **Cast iron housing for maximum rigidity under load. Large oil reservoir, splash lubrication.**
- **Leakproof oil seals.**
- **Dynamically balanced die-cast aluminum rotor. Impregnated windings assure protection from moisture, dust, and oil.**
- **Ball bearing motor for trouble-free operation.**

FOOTE BROS.
Better Power Transmission Through Better Gears

Write for Bulletin GMA

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 So. Western Blvd.
Chicago 9, Ill.

Send me Bulletin GMA on Foote Bros.-Louis Allis Gearmotors.

Name.....

Company.....

Position.....

Company Address.....

City.....*Zone*.....*State*.....

Again the time has come 1943 to ask your company, and every company, to

Get in the 1951 SCRAP

FOR every ton of ingot steel produced, at least a half-ton of iron and steel scrap must have *previously* reached the furnaces. Steel is currently being produced at full capacity, more than 100 million ingot tons annually—and there is a developing scrap shortage of serious proportions. Just as in the early years of World War II, the steel industry asks the help of *all* industry to relieve the situation.

TWO IMPORTANT THINGS TO DO

(1) CLEAN OUT YOUR PLANT SCRAP. This is a job that every company can do. Old, worn-out or out-moded and replaced machinery and equipment, rails, structural parts, etc. constitute the "heavy melting scrap" which the steel industry needs most. Clean up *your* plant and yards—move out this heavy scrap into the channels of use.

(2) HURRY BACK YOUR WORKING SCRAP. Don't let the waste of metal-working—turnings, borings, punchings, crop ends, etc.—lie around the plant a day longer than necessary. Keep it moving, back to the furnaces. And doubly important, *be sure to classify and segregate your alloy steel scrap.* Thus handled, it not only commands a higher price, but will help to conserve the nation's supply of critical alloys, practically all of which are highly essential.

Contributed in the National Interest by

ALLEGHENY LUDLUM STEEL·CORPORATION

Henry W. Oliver Building • Pittsburgh 22, Penna.

W&D CL 3617

They keep coming back for more!

Companies that have bought VU Boilers *continue to buy them.* In fact, a substantial proportion of all VU Units, in service and on order, have been purchased by organizations whose selection reflects their own first-hand experience. *For example* —

A STEEL COMPANY now has a total of eleven VU Boilers in four different plants. Starting with three units in 1936, it has reordered three times . . . most recently in the fall of last year with an order for three more units.

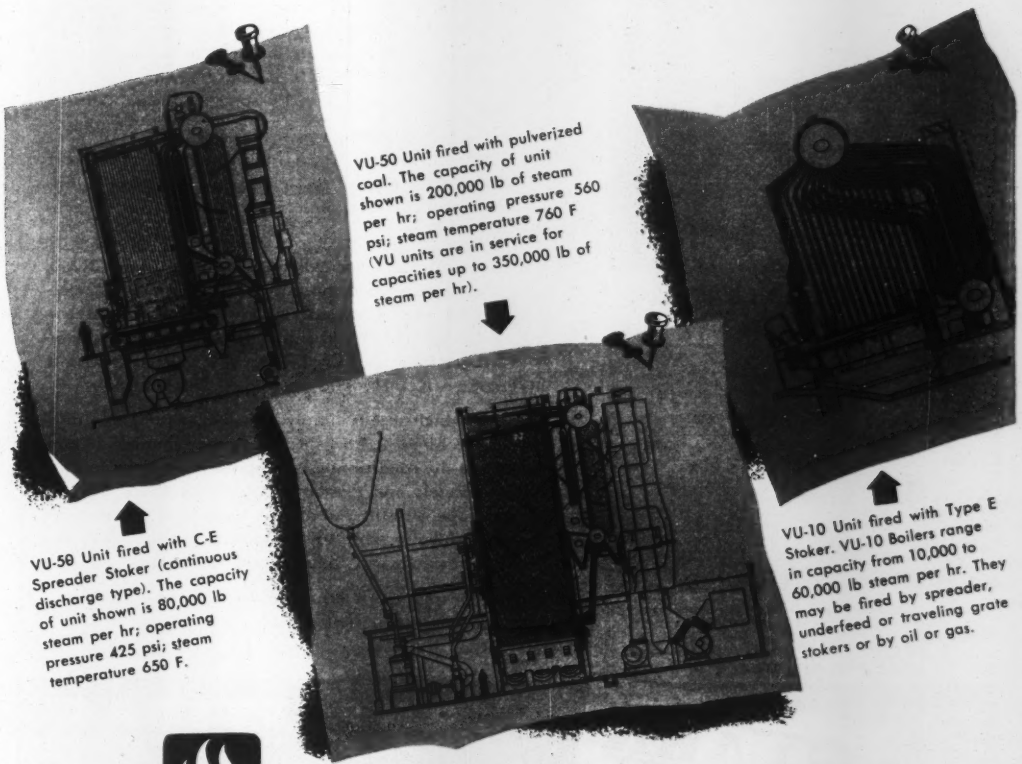
A TEXTILE MANUFACTURER ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another textile company installed one unit in 1945, a second in 1949 and has just ordered another.

A REFINING COMPANY ordered one VU Unit in 1937, another in 1940 and another in 1949 for one of its plants; also two in 1942 and one in 1947 for another plant.

A SEWAGE TREATMENT PLANT in one of America's large cities is another consistent buyer of VU Boilers. Its initial order in 1936 was for two units. Since then it has reordered three times, and now has a total of seven VU Boilers in service.

• • •

The story is the same wherever you go — in all sections of the country American industry is ordering and *reordering* VU Units. Why? Because the VU's advanced design, sound construction and consistent reliability have become a service-proved answer to lower steam costs. Once you have a VU Unit in service you soon *know* why so many large steam users *keep coming back for more.* B-481A



VU-50 Unit fired with pulverized coal. The capacity of unit shown is 200,000 lb of steam per hr; operating pressure 560 psi; steam temperature 760 F (VU units are in service for capacities up to 350,000 lb of steam per hr).

VU-5B Unit fired with C-E Spreader Stoker (continuous discharge type). The capacity of unit shown is 80,000 lb steam per hr; operating pressure 425 psi; steam temperature 650 F.

VU-10 Unit fired with Type E Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb steam per hr. They may be fired by spreader, underfeed or traveling grate stokers or by oil or gas.

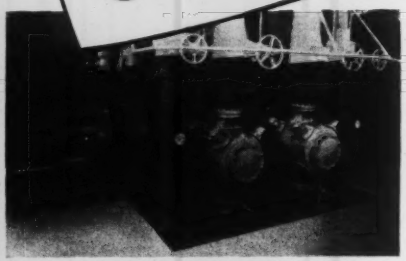
COMBUSTION ENGINEERING — SUPERHEATER, INC.

Combustion Engineering Building
200 Madison Avenue • New York 16, N. Y.

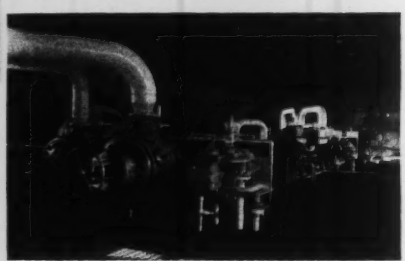
5 types of compressors at Spencer Chemical, signify...

Clark Versatility!

One of nine Clark SCRA, 2750 bhp, steam-engine-driven compressors handling feed gas for ammonia manufacture. Spencer Chemical Co.



Clark CMA-4, 300 bhp, 600 rpm, balanced/opposed, motor-driven compressor for carbon dioxide liquefaction service. Spencer Chemical Co.



Two Clark CRA-6, 1750 bhp, 327 rpm, balanced/opposed, motor-driven compressors for hydrogen and carbon monoxide feed gas service. Spencer Chemical Co.

It may be said that the list of compressors in service at the Jayhawk Works of Spencer Chemical Company reads like a Clark catalog. For there are sixteen Clark compressors, representing five basic models, shouldering the main compressor requirements of this Pittsburg, Kansas plant.

But, the significant aspect of these Spencer installations is not the *number* of Clark units involved, rather the *versatility* of the Clark line that enables complete fulfillment of any and all requirements — no matter how diversified!

In this one plant, for example, are two Clark CRA-6, electric-motor-driven compressors; a Clark CMA-4, electric-motor-driven unit; and nine Clark SCRA, steam-engine-driven models (all illustrated and described herewith); as well as three Clark MA-4 and one Clark RAS-6, gas-engine-driven compressors (not shown).

All of which means simply this: No matter how difficult the problem . . . how specialized the function . . . how diversified the conditions . . . compressor requirements are met completely and most competently by Clark. For, by reason of the versatility of its line, Clark is in the favorable position of being able to recommend without bias and build to anyone's best interests and preferences.

Your nearest Clark representative has data and literature to support these claims.

SEE the difference in . . .

CLARK® **COMPRESSORS**

Midget Angle • Right Angle • Big Angle • Electric-Driven • Centrifugal

CLARK BROS. CO., INC. One of The Dresser Industries **OLEAN, N. Y.**

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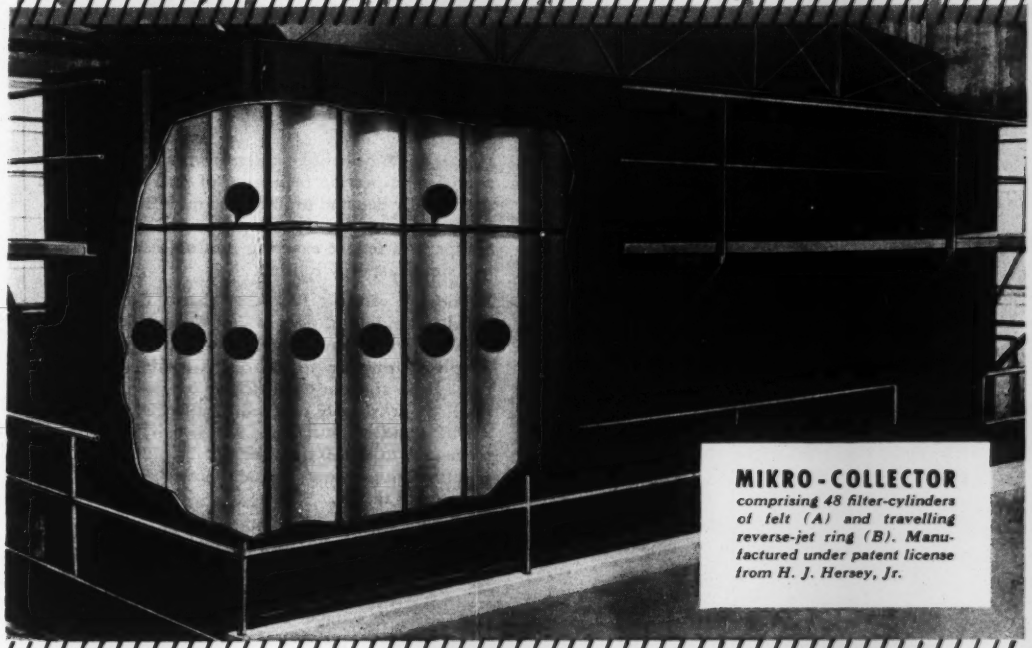
Optimum dust collection . . .



MIKRO-COLLECTOR
comprising 48 filter-cylinders of felt (A) and travelling reverse-jet ring (B). Manufactured under patent license from H. J. Hersey, Jr.

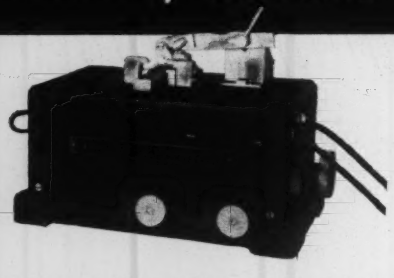
with AMERICAN Felt

The unique principles employed in the MIKRO-COLLECTOR enable dust recovery (up to 99.999%) and phenomenal filter rates. Pulverizing Machinery Company, Summit, New Jersey, the manufacturer, states that American Felt's wool felt has been found to be a superior filter medium, permitting the easy handling of damp or dry, light or heavy dust-loaded air streams. With the Hersey travelling reverse-jet principle uniform filter resistance is maintained, thus assuring uniform air flow. Used in the handling and recovery of a wide range of dusts and powders, the MIKRO-COLLECTOR serves to eliminate atmospheric pollution, as well as providing full recovery of a valuable product. Dangerous or noxious dusts and minute size dust particles are easily handled. Installations for the handling of ultra-fine radioactive dusts during the past year have a combined capacity of more than 100,000 cfm. The MIKRO-COLLECTOR is manufactured with single and multiple filter cylinders of varying diameters and lengths to meet every requirement.

American Felt Company
TRADE MARK

GENERAL OFFICES: 50 GLENVILLE ROAD, GLENVILLE, CONN. — ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn. — PLANTS: Glenville, Conn., Franklin, Mass., Newburgh, N. Y., Detroit, Mich.; Westerly, R. I. — SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal

Faster, Closer QUALITY CONTROL



Special gaging fixture made by Brown & Sharpe for inspecting dimensions, side parallelism, and side squareness of cutter blades. Employs 4 Gage Head Cartridges . . . used with 4 Amplifiers.

Brown & Sharpe Electronic Amplifiers with built-to-order Gaging Fixtures

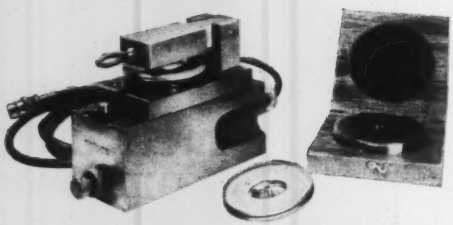
Here's an unbeatable set-up for fast, low-cost precision inspection or gaging of many small parts that usually demand high-skilled measurements. Special gaging fixtures, custom-built by Brown & Sharpe, can reduce exacting measurements to a simple, speedy routine.

Employing versatile Brown & Sharpe Gage Head Cartridges, these low-cost fixtures in combination with Brown & Sharpe Electronic Amplifiers provide flexibility that enables gaging to be done right at the machine or production line. Work is easily checked by .0001" to .00001", and measurements are visually magnified from 1800 to 18,000 times by the Amplifier . . . permitting operators to read "tenths", or finer, as easily as inches.

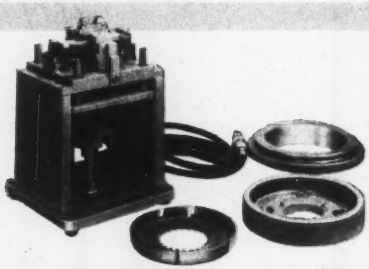
Investigate Brown & Sharpe Electronic Gaging Equipment for improving *your* quality control. It can be applied for gaging thickness, length, angle, parallelism, diameter, taper or combinations of several dimensions. For details write Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

Electronic Amplifier No. 950.

WE URGE BUYING THROUGH THE DISTRIBUTOR



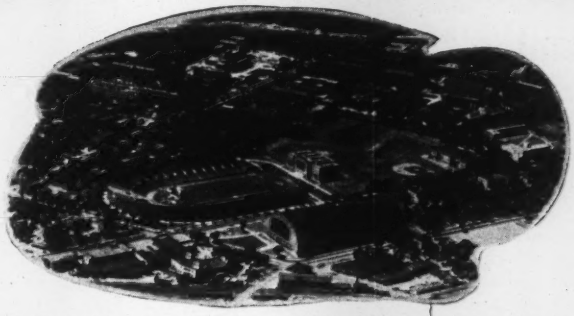
Special gaging fixture, custom-made by Brown & Sharpe, permits gaging of meter valve plate flatness to .00001", when used with Brown & Sharpe Amplifier.



Custom-made fixture, employing Brown & Sharpe Gage Head Cartridge and one Amplifier, simultaneously measures major and minor I.D.'s of tapered bores and indicates accuracy of internal angle.

Brown & Sharpe B·S

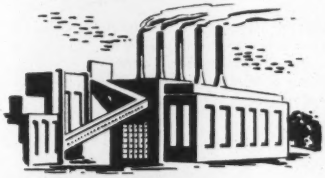
American Blower... a time-honored name in air handling



In the Twin Cities, commerce, industry and public utilities have made use of American Blower's Branch Office by calling Geneva 7428 in Minneapolis or Nestor 6072 in St. Paul. To contact the American Blower Branch Office in your city, consult your phone book.

STUDENTS BENEFIT . . .

Children in Minneapolis and St. Paul schools now learn their three R's in real classroom comfort, thanks to American Blower Nesbitt Syncretizers. For winter heating, fresh air is drawn in from outside, warmed, and continuously circulated without drafts. Result . . . rooms are more pleasant, more inviting. Available with or without matching storage cabinets, the graceful styling of Nesbitt Syncretizers complements not only school rooms but hospital rooms, lobbies and offices, too. Can we help you?



EFFICIENT POWER . . .

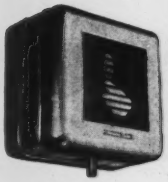
If you're faced with the need of expanding or enlarging power plant facilities, consult American Blower. You'll find our Mechanical Draft Fans measure up to the most exacting power plant requirements. High static efficiency, low RPM, low tip speed and low inlet velocity are but a few of the many reasons these fans have enjoyed such wide acceptance. Our nearest branch office will be glad to furnish you with complete data.

BETTER WORKING CONDITIONS

In the industries where equipment is needed to handle fumes and gases at high temperatures, American Blower Type E Industrial Fans are just the ticket. They are available in standard sizes, designed to operate dependably and efficiently under rugged conditions. With low power consumption, too! Our branch office personnel are experienced engineers who can often save you time with on-the-spot suggestions. Why not call today?

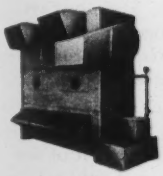
YOUR BUSINESS . . .

No matter what business you're in, you can count on American Blower heating, cooling, drying, air conditioning or air handling equipment to do the job better, more economically. Phone or write our nearest branch office for data.

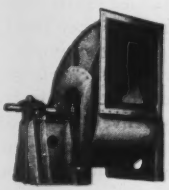


Unit Heaters

Ventura Fans



Air Conditioning Equipment



Industrial Fans

Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Farval system on crusher pays for itself in 4 months

IN March, 1949, a Farval Automatic Lubrication System was installed on this Fairmount roll crusher in an eastern cement plant. Noteworthy savings were evident immediately — in grease consumption, oiling labor and bearing expense.

Before Farval, 25 pounds of grease was used to lubricate the crusher every 8-hour shift. Now grease consumption is less than 10 pounds per shift. This represents a cost saving of $1,086 per year on lubricant.

Before Farval, it took one man's time to lubricate the crusher and keep the floor clean. Now a man from the Hammer Mill floor below comes up to the crusher occasionally, merely to check the Farval system and sweep the floor. This represents a saving on labor of between $2,500 and $3,000 a year.

Before Farval, a set of crusher bearings lasted only a year. After the Farval system had been in service 12 months, an inspection of the bearings showed them to be in excellent condition. Bearing replacement expense saved was $1,000.

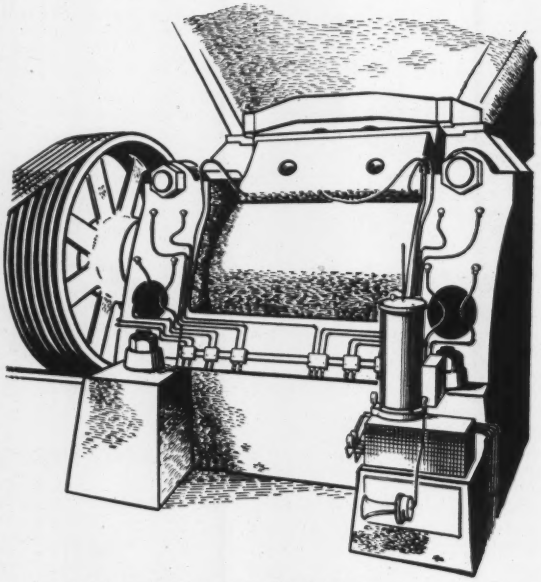
Thus savings the first year, due to Farval, totalled at least $4,500—considerably more than three times the entire cost of the centralized lubrication system. In short, Farval paid for itself in less than 4 months—and now pays dividends in savings at the rate of $375 a month.

Farval is the original (patented) Dualine system of centralized lubrication that has proven itself through years of service. The Farval valve has only two moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want, exactly measured — as often as desired. Indicators at every bearing show that each valve has functioned.

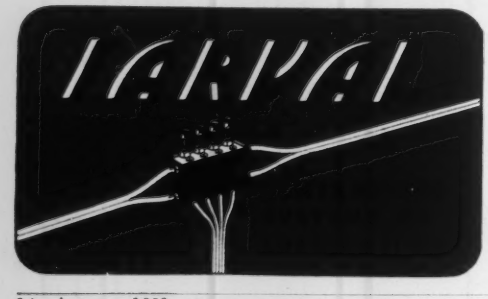
Write for Bulletin No. 25 for full details. The Farval Corporation, 3264 E. 80th St., Cleveland 4, O.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

FARVAL—*Studies in Centralized Lubrication* No. 120



$4,500 saved the first year! Monthly savings since then of at least $375! That's the report in this case of a Farval-protected Fairmount roll crusher. Farval is giving similar valuable protection to the equipment in thousands of other industrial plants.



This Bulletin HAS MANY OF THE ANSWERS TO YOUR QUESTIONS ON Air Cleaning

It Covers:

- AIR POLLUTION CONTROL
- "BUFFALO" "DC" STATIC WASHERS
- "BUFFALO" HYDRO VOLUTE SCRUBBERS
- "BUFFALO" WET GLASS CELL AIR WASHERS
- "BUFFALO" CUPOLA WASHERS
- "BUFFALO" GAS SCRUBBERS
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"Buffalo"

KNOW-HOW IS AT YOUR SERVICE!

Fifty years ago, "Buffalo" Air Washers were solving dust problems for industry. Today our vast background of experience in dust and fume control is at your disposal. Whether your problem is the elimination of a nuisance or air cleaning for process control, "Buffalo" has the equipment and the know-how to help you solve it. Call on us for recommendations.

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BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, N. Y.

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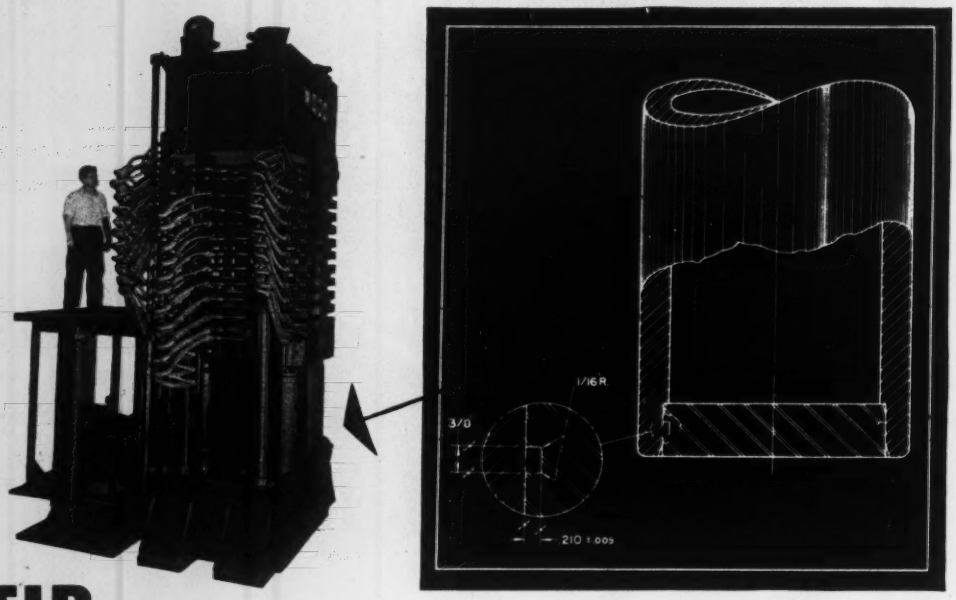
VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING



TIP...

FOR THE DESIGNER

No Maintenance... No Replacement... A Permanent Seal with

LINEAR "O" RINGS

Here is a dramatic expression of confidence in the life and dependability of LINEAR "O" Rings!

In this 880 ton steam laminating press built by R. D. Wood Company, LINEAR "O" Rings are expected to fulfill their sealing job *permanently—never to be removed—never to be replaced for the life of the machine!*

The "O" Ring is used in sealing cylinders of a 2-piece construction. Tightness of seal is made possible by installing the "O" Rings in place and shrink-fitting the head into the cylinder. When hydraulic pressure is applied to the cylinder, the fluid forces its way between the inside cylinder wall and the head, spreading over the exposed area of the "O" Ring. The pressure expands the rubber ring between the cylinder wall and the groove in the head, thus permanently sealing the joint.

Produced under rigid supervision and held to the closest of tolerances, LINEAR "O" Rings can be depended upon for continuous and lasting service... mighty important in these days of critical material shortages.

To build it better—to make it simpler—it will pay you to consult LINEAR.

LINEAR "O" Rings are compounded of natural or synthetic rubber, fluorethylene polymers and "Silastics"... are molded in a complete range of J.I.C. and A.N. standard sizes, as well as hundreds of non-standard sizes for special uses.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK STREET, PHILADELPHIA 35, PA.

Remember—

the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

In special alloy piping systems, alloy TUBE-TURN *Welding Lap Joint Stub Ends permit use of lower-cost carbon-steel flanges as shown in cut-away view.*

Special alloys lick special piping problems

Write Dept. F-8 for free booklet "Pipe and Fitting Materials" which gives specifications, properties and welding procedures for various materials.

YOU can overcome special problems of corrosion, fluid contamination, pressure, or temperature by selecting pipe and welding fittings of special materials.

Tube Turns, Inc. continually studies the proper application of different materials to piping systems. The complete line of TUBE-TURN Welding Fittings is available in more than forty different alloys. Today's piping engineer can choose from intermediate and high alloy steels containing chromium, nickel, or both; commercially pure nickel, copper, and aluminum; and alloys of these.

Get in touch with your nearby Tube Turns' Distributor. You'll find one in every principal city.

"Be sure you see the double tt*"*

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

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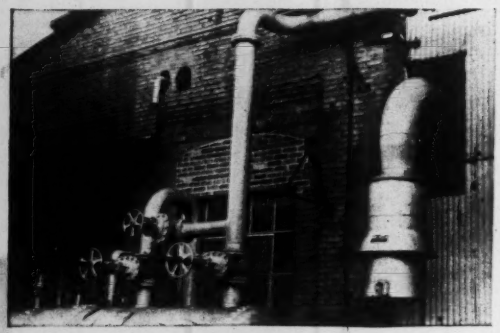
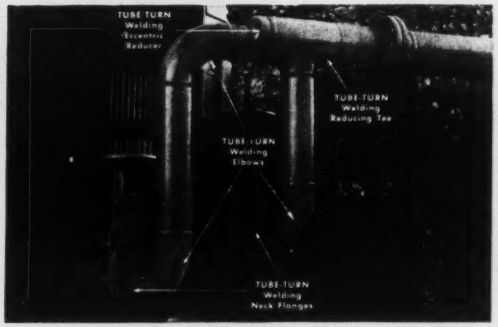
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

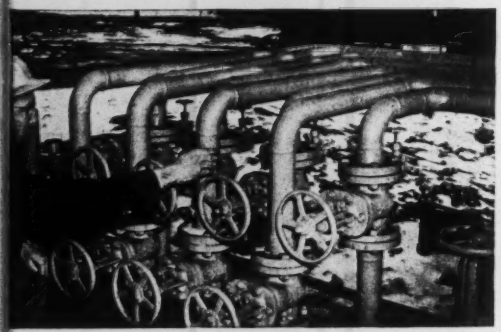
Piping construction simplified by wide range of TUBE-TURN Welding Fittings



Welding complex process piping calls for a wide variety of fittings and flanges. In this installation, air is drawn into compressor through a 16-inch line, connected to an outdoor filter through a TUBE-TURN Welding Reducer. Air at 100 lbs. is piped to the compressor tank through an 8-inch welded line.



Manifold serves air lines to various shops. Matching the two 8-inch lines to the 12-inch line here was no problem. Use of a TUBE-TURN Reducing Outlet Tee and a TUBE-TURN Eccentric Reducer made the construction job easy. The main line can be opened easily at the TUBE-TURN Welding Flanges.



Small lines tap off fire foam chemical manifold, lead to storage areas and other critical locations. Leakage or weak joints here could be disastrous. Welded piping with strong TUBE-TURN Welding Fittings makes this fire protection reliable.

In fabricating, welders appreciate the true circularity of TUBE-TURN Welding Fittings. To fill an immediate need, a welding elbow is often cut to make an odd-angle welding fitting. Unique forging process assures that TUBE-TURN Welding Elbows can be cut at any angle and still match the pipe for proper welds.

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Firth Sterling

STAR·MO M-2

conserves critical materials to everyone's ADVANTAGE!

- ★ 29% Lower Base Price
- ★ 7% More Tools per Pound *(lower spec. grav.)*
- ★ Tougher than standard 18-4-1 Class B High Speed
- ★ Very good abrasion resistance
- ★ Lower Hardening Heats

Lower power consumption
Reduced wear on salt bath equipment

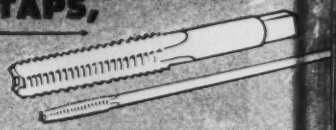
Star-Mo (M2) turns the necessary substitution requirements of NPA to *big advantages* for High Speed steel users.

Firth Sterling's Star-Mo (M2) is tougher than the standard 18-4-1 Class B High Speed when it is in the heat treated condition. Star-Mo (M2) also has an abrasion resisting quality approximately equal to the standard Class B 18-4-1 steel.

Write for Bulletin SL-2036

Specify STAR-MO (M-2) for . . .

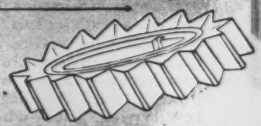
TAPS,



TWIST DRILLS,

REAMERS,

MILLING CUTTERS,



BROACHES,

THREAD CHASERS,
LATHE and
PLANER TOOLS

Firth Sterling

Offices and Warehouses:* HARTFORD, NEW YORK*, PHILADELPHIA*, PITTSBURGH*, CLEVELAND, DAYTON*, DETROIT, CHICAGO, BIRMINGHAM*, LOS ANGELES.

8-243

Try these for ideas . . . for savings, too!

● In today's stepped-up defense production, the ways we can help you on your bellows assemblies needs will make important savings for you.

If you're looking for ideas, Sylphon bellows assemblies offer *plenty*. They open and close valves, dampers, etc., absorb expansion, provide packless construction—have a whole list of practical uses. The diagrams show a few typical uses—where there's a design problem involving control of temperatures or pressures.

Or, take design and development. You may have a problem similar to one we have solved for another customer. You may need assemblies for a specific application. Whatever your need, we'll work with you to develop *exactly* what you require.

On production—you can confidently turn over the complete job to us. You're relieved of production worries. Our skilled personnel and complete facilities can turn out your requirements, simple or complex, on schedule.

Talk over your requirements with us. As specialists in this field for half-a-century, our experience can be more valuable than ever to you.

Wide range of metals and sizes. Send for information. Ask for idea-packed Catalog PK-1200.

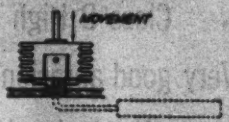


Fig. 1 Thermostatic Motor—This type of assembly is widely used in temperature regulators, etc., where a thermostatic charge is confined in the bellows and where a valve, switch, damper, etc. is to be operated in response to temperature changes.

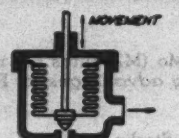


Fig. 2 Packless Construction—Illustrating packless valve construction. Same principle used to seal stem movement or adjustment in many types of apparatus.

TEMPERATURE CONTROLS

FULTON SYLPHON DIVISION Knoxville 4, Tenn.

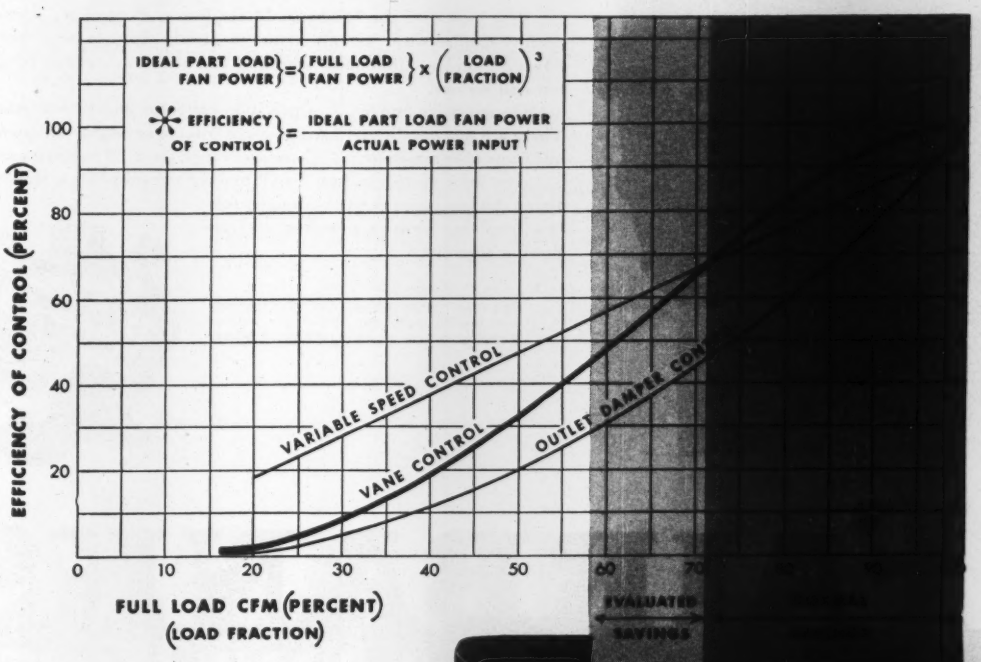
Robertshaw-Fulton

BELLOWS ASSEMBLIES • BELLOWS DEVICES

BRIDGEPORT THERMOSTAT DIVISION Bridgeport 1, Conn.

FOR PART LOADS

USE STURTEVANT VANE CONTROL® FOR HIGH EFFICIENCY AT LOW COST



If you operate in this range—and most plants do—VANE CONTROL is the economical choice

Have you ever considered the relative efficiencies of methods of mechanical draft fan volume control—and then evaluated them against first cost? Do so, and you will find Sturtevant Inlet VANE CONTROL is the best. It is high in *efficiency of control** and low in first cost.

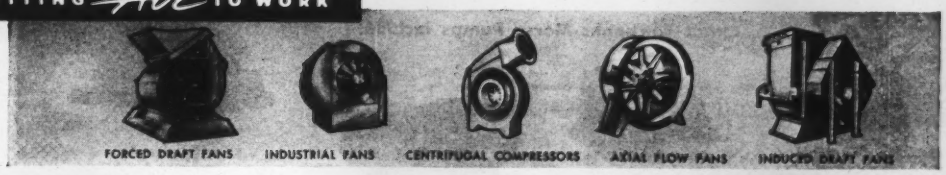
Whether for forced or induced draft, the *new* VANE CONTROL is a simple and reliable regulator of fan output—a control which responds instantly to varied demands, and yields major power savings at reduced loads.

A new Bulletin, DB 92-810, describes the mechanical improvements developed for Sturtevant VANE CONTROL and its use in mechanical draft, industrial and ventilating applications. Write today for a free copy. Westinghouse Electric Corp., Sturtevant Division, 155 Damon St., Hyde Park, Boston 36, Mass.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING *Air* TO WORK

J-80230

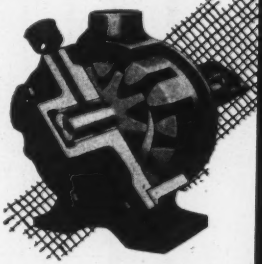


IF YOU'RE LOOKING FOR

Positive Pumping Performance

. . . then look over the Fairbanks-Morse Rotary Pump line. These positive-displacement pumps assure a steady flow of any free-flowing liquid . . . minimize vibration and shock . . . assure long, low-cost service.

Only *two* parts move . . . a precision-cut rotor and pinion gear. There are no complicated parts to cause trouble or require frequent adjustment or maintenance. Capacities range from 1.3 to 450 g.p.m. . . . sizes from ⅜ to 5 inches. You'll find a Fairbanks-Morse Rotary Pump the ideal answer to any design problem involving positive pumping of free-flowing liquids.



This cross-section clearly illustrates the only two moving parts that impart the positive pumping action of Fairbanks-Morse Rotary Pumps.

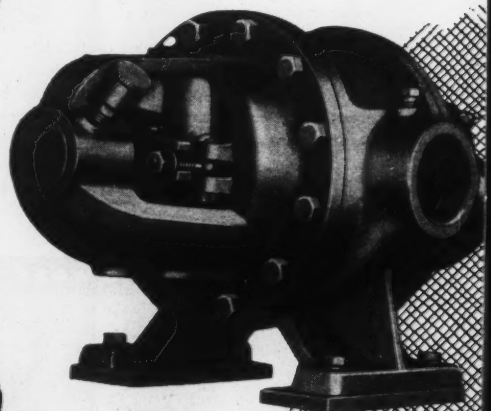
FAIRBANKS

A NAME WORTH

OR, MULTI-STAGE BENEFITS FROM A

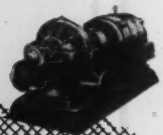
Single Stage Pump

. . . then look over Fairbanks-Morse Westco Turbine type pumps. A Westco is the one pump that gives you multi-stage benefits from a single stage pump . . . that reduces operating and maintenance costs through balanced impellers and replaceable liners . . . that handles widely varying heads with little loss of capacity with *no* change in operating speed . . . that minimizes vapor locking. If you need these advantages in your designs, then you need Westco. Sizes from 1 to 200 g.p.m.



Other Fairbanks-Morse Pumps include:

Side-Suction Centrifugals

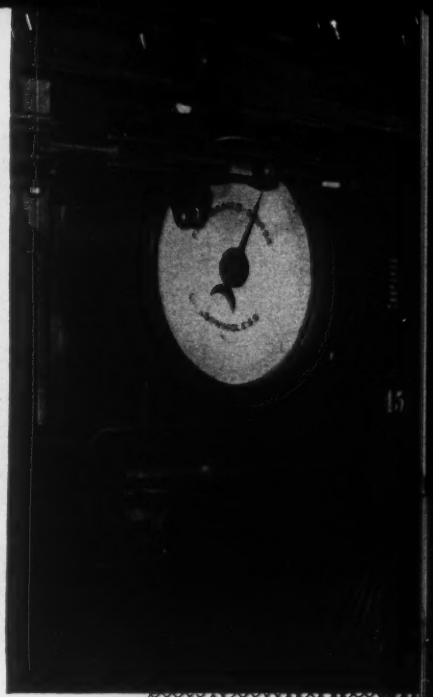


Split-Case Centrifugals

Builtogether Centrifugals

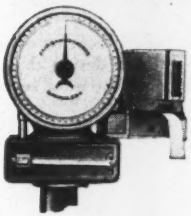
IF IT'S A

Matter of Record....



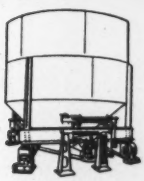
If the matter of automatic recording of weights . . . if accurate automatic control of batching, processing, materials handling or production machinery are required essentials of your designs, check the possibilities of Fairbanks-Morse Printomatic Weighers.

These lastingly accurate weighing instruments record weights automatically . . . assure accurate permanent records. They can, through the use of electronics, accurately control machines or proportioning equipment. They can be fitted in as an essential part of a production or materials handling line . . . control material flows. For any operation involving automatic weighing or materials control, it will pay you to check Printomatic.



MORSE

REMEMBERING



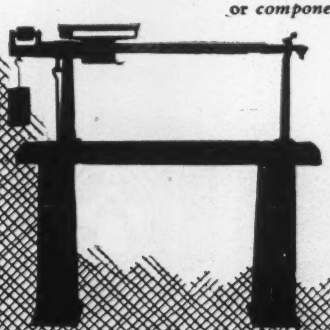
Hopper Scale

IF IT'S A

Matter of Weight

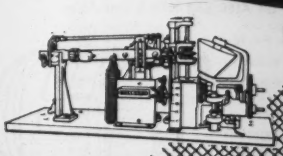
the complete line of Fairbanks-Morse Scales provides an economical answer to any weighing problem. Beam and dial scales in a wide variety of types and capacities . . . truck scales . . . hopper scales . . . railroad track scales . . . and special service scales . . . fit any weighing requirement. Fairbanks-Morse Scales or *component scale parts* can be supplied to fit right into your equipment for weight or control operations. A Fairbanks-Morse weighing expert will be happy to work with you on any scale problem.

Portable Dial Scale



Full Capacity Beam Scale

Weigh Can Scale



Belt Conveyor Scale

..YOU WANT THIS ROTOR DESIGN...

It's Copperspun!

If you buy or use motors, chances are that most of them are of the polyphase squirrel cage type — the most widely used class of integral horsepower motors made — for sustained heavy-duty drives in almost every class of service.

In rotor design, such service separates the good from the poor — and highlights your need for Fairbanks-Morse motors with Copperspun rotors, made through an exclusive centrifugal casting procedure developed by Fairbanks-Morse.

For in Copperspun rotors, you get the benefits of superior electrical characteristics — plus a design that is mechanically stronger for withstanding the most severe working conditions.

FAIRBANKS

A NAME WORTH

FOR POLYPHASE SQUIRREL-CAGE MOTORS

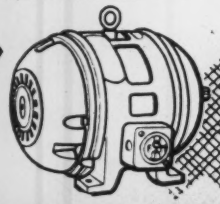
with Copperspun Rotors!

Here are a few in the complete Fairbanks-Morse line

GENERAL PURPOSE, drip-proof motors mountable in any position with full protection against flying chips, falling particles, dripping liquids, etc.

AXIAL AIR-GAP MOTORS: Averaging 30% lighter and 40% shorter overall—with flywheel effect three times that of corresponding ratings of conventional motors. Add to appearance, decrease size and weight of any driven machine. Meet all AIEE and NEMA standards.

TOTALLY ENCLOSED FAN-COOLED motors operate economically, safely under adverse conditions, including corrosive gas, vapors, steam or where metallic particles, abrasive dust and/or other materials are in the air. Available with Underwriters labels for use in Class 2, Group G hazardous locations.



FOR THESE EXCLUSIVE ADVANTAGES

Compare!

The Fairbanks-Morse Copperspun rotor design shows up at its best under comparison. It contrasts the mechanical strength and superior electrical characteristics of copper—against the poorer showing of aluminum and other white metal alloys. It contrasts new standards for uniformity and strength made possible through its precisely controlled centrifugal casting—against the results obtainable through standard, even old-fashioned, manufacturing procedures.

Finally, comparison drives home the virtues of indestructibility, homogeneity and high electrical efficiency. That means more satisfactory operation of motors with the Fairbanks-Morse Copperspun rotor.

ONLY COPPERSPUN ROTOR OFFERS THESE ADVANTAGES:

- ★ A truly one-piece indestructible copper rotor winding.
- ★ Withstands higher temperatures: (melting point 2,000° F. for Copper, 1,100° F. for Aluminum)
- ★ High electrical and thermal conductivity.
- ★ Dense, uniform grain structure.
- ★ Separately mounted fans: permitting complete overall machining, better quality control, better dynamic balance.

FAIRBANKS-MORSE

REMEMBERING

THESE ARE YOUR FAIRBANKS-MORSE SALES CENTERS

ATLANTA 3, GEORGIA
760 Lee St., S. W.
AMhurst 7701

BALTIMORE 18, MD.
659 E. 25th St.
BEImont 5258

BIRMINGHAM 1, ALA.
626 N. Ninth St. Zone 4
3-6546

BOSTON 10, MASS.
178 Atlantic Avenue
LAfayette 3-3600

BUFFALO 3, N. Y.
33 Franklin St.
Lincoln 4210

CHARLOTTE 2, N. C.
Liberty Life Bldg.
Room 605
6-2893

CHICAGO 5, ILLINOIS
1550 S. State St.
HArrison 7-7100

CINCINNATI 2, OHIO
49 Central Avenue
MAin 3010

CLEVELAND 14, OHIO
3000 W. 117th St.
CLearwater 1-3300

COLUMBUS 8, OHIO
1034 Goodale Blvd.
WAlnut 8581

DALLAS 2, TEXAS
1713 N. Market Street
CEntral 4347

DENVER 2, COLO.
1500 17th Street
TAbor 6241

DES MOINES 17, IOWA
2017 Dean Avenue
6-1189

DETROIT 13, MICHIGAN
11110 East Warren Ave.
VAlley 1-7100

DULUTH 2, MINN.
Board of Trade Bldg.
2-7538

HOUSTON 13, TEXAS
5521 Navigation Blvd.
WAyside 2159—(LD 506)

INDIANAPOLIS 2, IND.
1499 N. Harding St.
FRanklin 3684
ATlantic 3092

JACKSONVILLE 6, FLA.
930 East Adams St.
5-6473

KANSAS CITY 7, MO.
1300 Liberty Street
Victor 6474

LOS ANGELES 11, CALIF.
4535 S. Soto Street
JEfferson 8151

LOUISVILLE 8, KY.
2008 So. Brook St.
CAlhoun 1469

MEMPHIS 7, TENN.
676 Jefferson Ave.
5-1614

MILWAUKEE 3, WIS.
404 N. Plankinton
DAly 8-0180

MINNEAPOLIS 15, MINN.
417 S. Fourth Street
MAin 4353

NEW ORLEANS 13, LA.
1000 St. Charles Ave.
RAymond 3115

NEW YORK 4, N. Y.
80 Broad St.
HAnover 2-7470

OMAHA 8, NEBRASKA
902 Harney St.
ATlantic 3122

PHILADELPHIA 8, PA.
401 N. Broad St.
WA 2-4100

PITTSBURGH 24, PA.
4301 Main Street
SChenley 1-3123

PORTLAND 14, OREGON
105 S. E. Taylor St.
EAst 0131

PROVIDENCE 3, R. I.
187 Pine Street
GAspee 1-1531

ST. LOUIS 2, MO.
217 South Eighth St.
CHestnut 7483

ST. PAUL 1, MINN.
220-26 E. Fifth Street
GArfield 4335

SALT LAKE CITY 1, UTAH
153 W. Second South St.
3-2108 & 3-5139

SAN FRANCISCO 7, CALIF.
630 Third Street
EXbrook 2-5855

SEATTLE 99, WASH.
Salmon Bay Terminal
ALder 6600

STUTTGART, ARK.
403 South Main St.
185

TULSA 3, OKLA.
1335 Hunt Bldg.
3-8231

WASHINGTON 5, D. C.
1000 Vermont Ave., N. W.
District 6694

FAIRBANKS-MORSE de MEXICO S. A.
Balderas 146, Mexico 1, D. F. Mexico
10 06 74 y 10 09 58

Export Division:
NEW YORK 4, N. Y.
80 Broad Street—HAnover 2-7470

Here's a that's

○ *for light weight*

○ *for insulation at very high temperatures*

If light weight—or good insulation at very high temperatures—interest you, here's a material worth knowing about. ALFRAX BI aluminum oxide refractory is literally made of bubbles.

Aluminum oxide, as you know, is inherently capable of withstanding very high temperatures—well over 3000° F. We make hollow spheres of Al_2O_3, specially bond them together, and get a finished refractory that has low heat capacity, good load strength, and is one of the best insulating materials available for high temperature jobs. And, a nine inch straight ALFRAX BI brick *weighs only 4.8 lbs.*

These unusual properties have made ALFRAX BI refractories ideal for such diverse applications as: Linings for chemical process kettle settings; Arches for aluminum reverberatory furnaces; Backing-up linings for synthesis gas generators; Arches and sidewalls for ceramic kilns. The one common denominator in each case being high heat — usually above 2600° F. (At lower temperatures, standard materials may prove adequate.)

Do any of these applications strike a responsive chord—perhaps where closer heat control is indicated? . . . or where a reduction in overall lining thickness would pay off? . . . or where a low heat capacity lining is desired?

Whatever your needs, bear in mind that ALFRAX BI refractory is only one of many Super Refractories by CARBORUNDUM — each of which (see box, opposite page) has unique properties ideally suited to certain applications.

Information is now available on all these Super Refractories. So send today for our valuable new booklet. No obligation, of course.

THE CARBORUNDUM COMPANY

Refractories Division • **Perth Amboy, New Jersey**

"Carborundum," "Carbofrax," "Monofrax" and "Alfrax" are registered trademarks which indicate manufacture by The Carborundum Company.

refractory material made of bubbles!

SUPER REFRACTORIES ARE ALSO USED

WHERE ABRASION OR EROSION IS SEVERE. Two Super Refractories—CARBOFRAX silicon carbide material and MONOFRAX K fused cast material—are within one index point of diamond hardness! As a result, both are exceptionally resistant to abrasion, either at room temperature or high heat.

WHERE HEAT CONDUCTIVITY IS NEEDED. At elevated temperatures CARBOFRAX refractories conduct heat as rapidly as chrome-nickel steels! This characteristic is invaluable in checkers, muffles, hearths, etc.

WHERE CHEMICAL ATTACK IS LIKELY. In general, all Super Refractories are either neutral or acid in nature—are widely used where chemical inertness is important.

WHERE STRENGTH IS IMPORTANT. No commercial tonnage refractories have greater strength than Super Refractories. All can withstand over 300 psi at 2750° F without crushing.

WHERE HIGH HEAT IS INVOLVED. They can be safely used at temperatures over 3000°F. They are very durable—are highly resistant to spalling and cracking. Some varieties are almost indispensable where flame impingement or violent temperature changes are present.

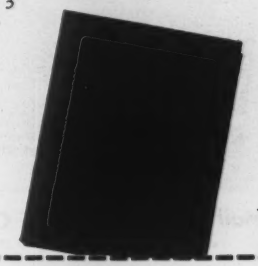
WHERE SPECIAL SHAPES ARE INDICATED. Practically all Super Refractories are available either as bricks or special shapes molded to close tolerances—including fitted joints, tubes, etc.

Do any of these suggest possible applications?

The important thing about Super Refractories by CARBORUNDUM is NOT just that they are "better" than standard fireclay refractories. The important thing is that they are actually *a class apart*—with many entirely different properties and applications. (For example, some of their properties—such as abrasion resistance—are important *regardless of whether high temperatures are involved.*)

Nor is their principal value simply that they cure trouble-spots where other materials (e.g., refractories, metals, etc.) fail to stand up. Their value usually lies in increasing capacity and reducing overall operating costs. (For example, regenerator checkers made of CARBOFRAX silicon carbide brick absorb and release over 3 times as much heat as checkers made of ordinary refractories when cycles are short.)

WHY NOT CHECK UP? We have a new booklet which outlines the unusual characteristics of these special purpose materials. The coupon will bring you the story—or one of our engineers will be happy to talk over your specific problems. We believe it could be mutually profitable.



This advertisement—one of a series—is presented in the belief that in the unusual properties of the various Super Refractories by CARBORUNDUM lies the key to many new or improved processes. We would like to talk over specific jobs with anyone who sees such possibilities.

Dept. P-81
Refractories Div., The Carborundum Co.
Perth Amboy, New Jersey

Please send your free booklet on properties of Super Refractories.

Name_____

Position_____

Company_____

Street_____

City_____ Zone____ State_____

HERE'S PROOF

FAST'S COUPLINGS cost you less to own and operate

ON BILLET MILL SINCE 1923

ON GAS BLOWER SINCE 1920

ON AMMONIA COMPRESSORS SINCE 1922

Fast's Couplings cost you less per year because they normally outlast the equipment they connect. That means their reasonable cost can be spread out over 20 years or more . . . assuring low-cost service without excessive maintenance costs!

Fast's basic design is *foolproof!* Instead of a perishable oil seal, Fast's are the only couplings to use a *permanent* metal-to-metal closure. Oil is always maintained at a safe level . . . whether the coupling is running or standing still . . . and dirt cannot get in. Fast's Couplings are compact, yet large enough to stand up under punishing service for 20 years or more!

When you specify Fast's Couplings, you get Koppers' valuable engineering service. In many cases where a special coupling appears necessary, Koppers engineers can modify a standard Fast's and save you money! Get the facts on Fast's Couplings. Mail the coupon for your copy of Fast's *free* Catalog today!

Mail Coupon for FREE Catalog

KOPPERS CO., INC., Fast's Coupling Dept.,
258 Scott Street, Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

Address.....

City.....Zone.....State.....

KOPPERS

FAST'S

THE ORIGINAL GEAR-TYPE

Couplings

INDUSTRY'S STANDARD FOR 31 YEARS

WHAT PRICE Precision

Typical "ground all over" series 1600 "precision" bearing.

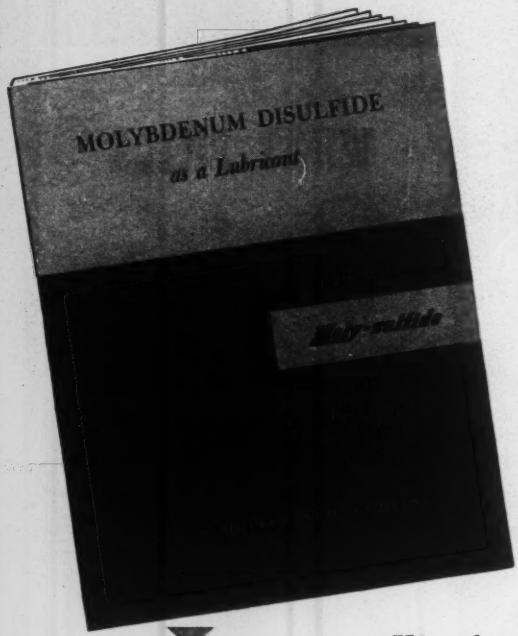
Typical "unground" series 3000 "precision type" bearing.

NICE

Yes, the bearings illustrated *are* identical, *except* for degree of precision. Because of the precision differences, there is a substantial difference in cost . . . NICE can provide bearings incorporating any degree or combination of precision features between the higher priced "ground all over" series 1600 and the low cost "unground" series 3000.

The specific requirements of your particular application should determine the precision features of the bearing you use. WHAT PRICE ARE YOU PAYING FOR PRECISION? ARE YOU BUYING MORE PRECISION THAN YOUR BEARING APPLICATION REQUIRES?

NICE



What do you know about MoS_2* as a lubricant?

* Molybdenum disulfide

You have probably heard reports, some enthusiastic, some conservative, of the remarkable properties of Molybdenum Disulfide as a new lubricant.

For those who wish to review published information on this subject, we have compiled a 55 page publication containing excerpts from authoritative technical papers. Copies are free—write now.

Please send your FREE Booklet
"MOLYBDENUM DISULFIDE AS A LUBRICANT"
BLOCK LETTERS PLEASE

Name .....

Position .....

Company .....

Address .....

....

ME-8

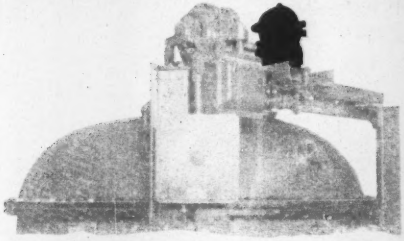
Climax Molybdenum Company
500 Fifth Avenue · New York City

MOLY

M51

"SAVED": $7.82 by buying a cheaply made speed reducer

LOST: $164.18, including a whole tankful of valuable chemicals



BOSTON REDUCTOR

Cost	$206.60
Cost of inferior speed reducer	$198.78
Difference in cost	$ 7.82
Value of spoiled chemicals	$100.00
Cost of disassembly and replacement (2 men, 3 hrs., @ $2.00 per hr.)	$ 12.00
Loss of profit and overhead on 3 hours production	$ 60.00
NET LOSS	$164.18

"SAVED": $5.70 by buying a cut price motorized speed reducer

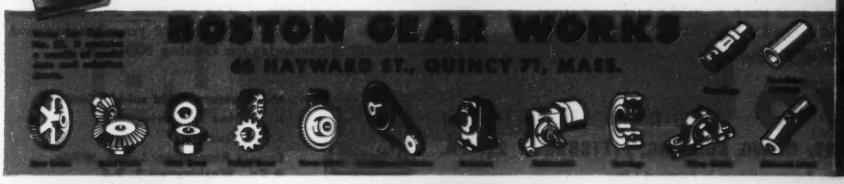
LOST: $155.90 worth of time, labor and defense production

BOSTON RATIOMOTOR

Cost	$140.50
Cost of "bargain counter" motorized speed reducer	$134.80
Difference in cost	$ 5.70
Cost of pulling down conveyor and replacing defective speed reducer (2 men, 4 hrs., @ $2.25 per hr.)	$ 18.00
Cost of toting parts while conveyor was idle (6 men, 6 hrs., @ $1.35 per hr.)	$ 48.60
Loss of profit and overhead	$ 95.00
NET LOSS	$155.90

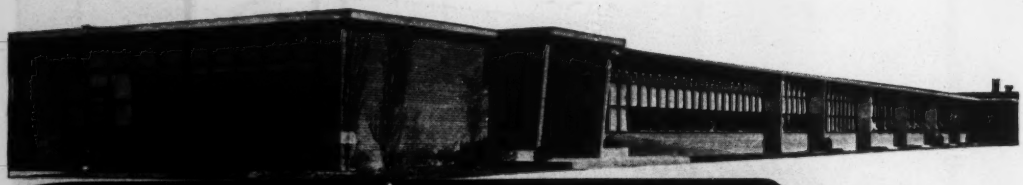
The *hidden quality* in BOSTON Reductors and Ratiomotors stems from BOSTON *Gear's* strict materials control, master craftsmanship and rigid inspection system, backed by 71 years of experience in the manufacture of standardized, interchangeable, stock power transmission equipment and parts.

Specify Standardized BOSTON *Gear* Products — Design them into your equipment — Get them from nearby stock.

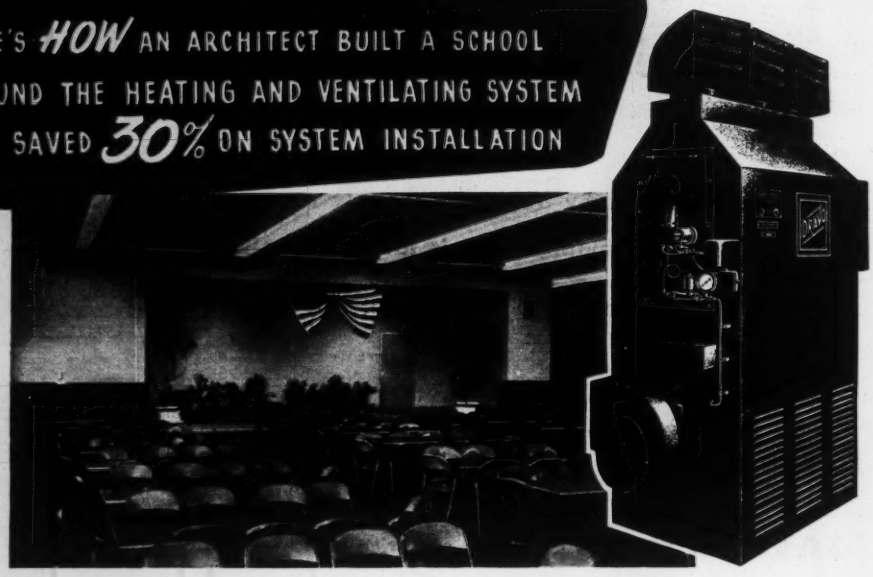


BOSTON GEAR STOCKS ARE HERE

AKRON, OHIO
ALBANY, NEW YORK
ALLENTOWN, PENNSYLVANIA
ATLANTA, GEORGIA
BALTIMORE, MARYLAND
BIRMINGHAM, ALABAMA
BOSTON, MASSACHUSETTS
BRIDGEPORT, CONNECTICUT
BROOKLYN, NEW YORK
BUFFALO, NEW YORK
CHARLOTTE, NORTH CAROLINA
CHATTANOOGA, TENNESSEE
CHICAGO, ILLINOIS
CINCINNATI, OHIO
CLEVELAND, OHIO
COLUMBUS, OHIO
DALLAS, TEXAS
DAYTON, OHIO
DENVER, COLORADO
DES MOINES, IOWA
DETROIT, MICHIGAN
GRAND RAPIDS, MICHIGAN
GREENSBORO, NORTH CAROLINA
HAMILTON, ONTARIO
HARTFORD, CONNECTICUT
HOUSTON, TEXAS
INDIANAPOLIS, INDIANA
JACKSONVILLE, FLORIDA
KANSAS CITY, MISSOURI
KNOXVILLE, TENNESSEE
LANCASTER, PENNSYLVANIA
LONDON, ONTARIO
LONG ISLAND CITY, NEW YORK
LOS ANGELES, CALIFORNIA
LOUISVILLE, KENTUCKY
MEMPHIS, TENNESSEE
MIAMI, FLORIDA
MILWAUKEE, WISCONSIN
MINNEAPOLIS, MINNESOTA
MONTREAL, QUEBEC
NEWARK, NEW JERSEY
NEW ORLEANS, LOUISIANA
NEW YORK, NEW YORK
OAKLAND, CALIFORNIA
PHILADELPHIA, PENNSYLVANIA
PITTSBURGH, PENNSYLVANIA
PORTLAND, OREGON
PROVIDENCE, RHODE ISLAND
QUEBEC, QUEBEC
QUINCY, MASSACHUSETTS
RICHMOND, VIRGINIA
ROCHESTER, NEW YORK
ST. LOUIS, MISSOURI
SAN FRANCISCO, CALIFORNIA
SEATTLE, WASHINGTON
SPRINGFIELD, MASSACHUSETTS
SYRACUSE, NEW YORK
TAMPA, FLORIDA
TOLEDO, OHIO
TORONTO, ONTARIO
TRENTON, NEW JERSEY
VANCOUVER, B. C.
WATERBURY, CONNECTICUT
WILKES-BARRE, PENNSYLVANIA
WINSTON-SALEM, NORTH CAROLINA
WORCESTER, MASSACHUSETTS



HERE'S *HOW* AN ARCHITECT BUILT A SCHOOL AROUND THE HEATING AND VENTILATING SYSTEM AND SAVED *30%* ON SYSTEM INSTALLATION



Listed by Underwriters' Laboratories

Approved by American Gas Association

Dravo "COUNTERFLO" Heaters operate automatically, provide constant-temperature fresh air to Hillsborough School.

When the Hillsborough, New Jersey, School was built, architect Jay C. VanNuys specified Dravo "Counterflo" Heaters and built the school *around* the heating and ventilating system, rather than trying to "fit" the system to the school.

Two direct-fired "Counterflo" Heaters, with an output of 1,750,000 Btu per hour each, heat 20,000 cu. ft./min. of fresh filtered air for the 21 rooms of the new school building during the winter months. In warm weather, these same heaters provide comfortable ventilation for the entire school.

The heating and ventilating system is thermostatically controlled and automatic in operation. The unique construction of the school eliminated the need for duct work.

THE RESULTS? The Dravo heater installation at 81¢ per sq. ft. cost 30% less than would a conventional "wet" system; heating and ventilating represented 7% of the total building cost.

Versatile Dravo Heaters can solve many school heating problems.

Dravo "Counterflo" Space Heaters are ideal for heating and ventilating such school facilities as . . . gymnasiums . . . auditoriums . . . stadium rooms . . . libraries . . . cafeterias . . . book stores . . . locker rooms . . . field houses . . . school garages . . . indoor swimming pools . . . manual training shops . . . laundries . . . classrooms.

DRAVO HEATERS OFFER YOU—

- **Low initial cost . . . users report 50% to 60% savings.**
- **Concentration of heat at working level.**
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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 73 NUMBER 8

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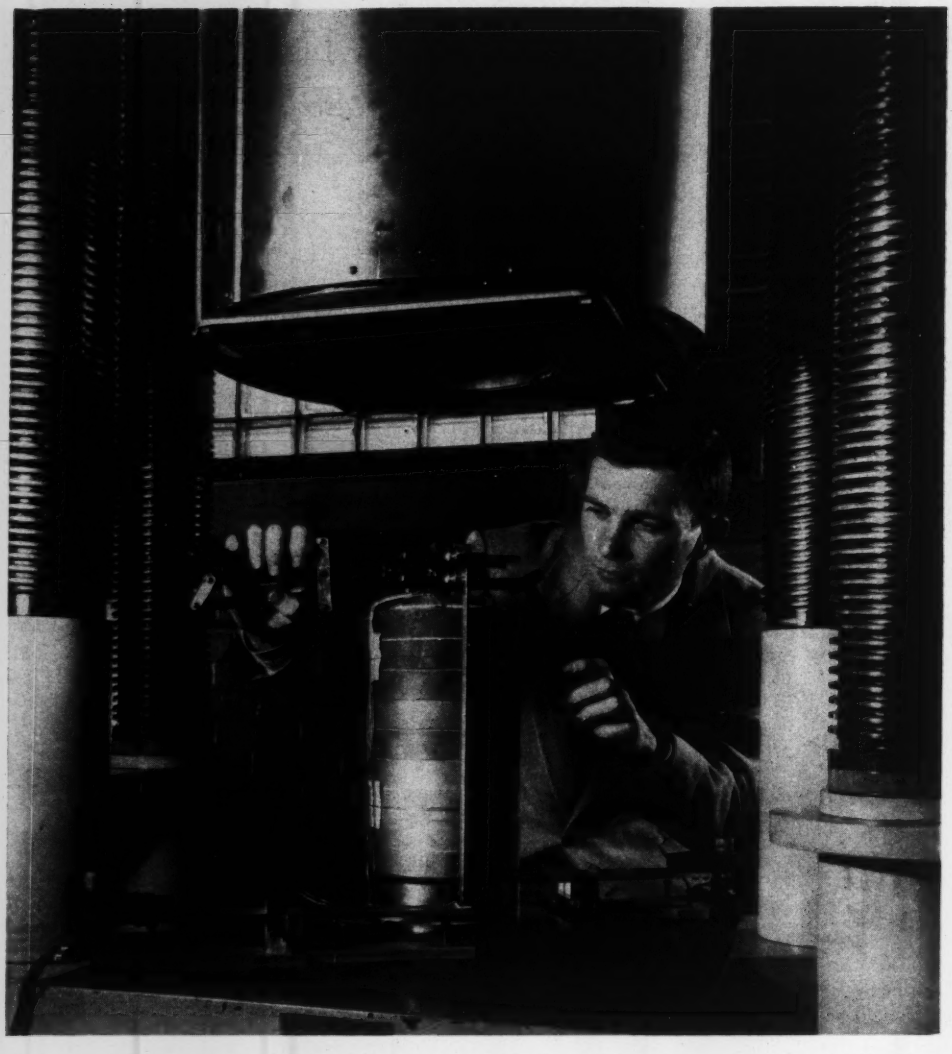

Testing Titanium at NACA's Langley Aeronautical Laboratory, Langley, Va.

(Titanium, a metal with certain advantages over aluminum alloy for use in high-speed aircraft, is tested for strength at high temperatures in this apparatus at the Structures Research Laboratory. The engineer is fastening a small, thin strip of the metal in place. After the circular electric oven is lowered, electronic apparatus arranged on a lever principle will measure deformation of the metal under various pressures and temperatures. See pp. 652–655 for details.)

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MECHANICAL ENGINEERING

AUGUST
1951

GEORGE A. STETSON, *Editor*

Get Out the Scrap

IN the face of a serious shortage of scrap urgently needed for the making of steel, the National Production Authority is engaged in an extensive program of seeking out existing supplies of this important industrial and defense resource and getting it moving into the normal channels of trade as quickly as possible. Co-operating with NPA are government, industrial, business, and agricultural groups, local chambers of commerce, steel plants, foundries, and scrap dealers, aided by a campaign initiated by the Advertising Council.

The campaign is aimed at management and administrative officials in a position to make policy decisions and assure quick action in situations where significant quantities of scrap are most likely to be found. To this end attention is directed specifically toward the collection of heavy random scrap and the writing off of idle obsolete machinery and equipment.

Few engineers need to be told of the importance of scrap to the steel industry. Nor do they need to be reminded that a shortage of steel is felt in practically every area in which they are engaged. Even engineers who may not be in the key positions of top management, where decisions affecting disposal of large amounts of unneeded machinery and equipment must be made, may be in a position to have firsthand knowledge of where such scrap is to be found and be competent to recommend its sale. Hence this appeal to get out the scrap is addressed to all engineers.

As a practical manner of setting up the large-scale programs that are needed to make appreciable headway in starting useless iron and steel on the way to the steel mills, the American Iron and Steel Institute has the following suggestions to make:

"1 Go after dormant scrap. Start an emergency inspection and inventory of all heavy steel, whether machines, equipment, beams, or plates. Sell everything you can possibly spare to your nearest scrap dealer.

"2 Keep the scrap flowing. Organize a cleanup committee, if you do not already have one. Continued inspection has been a vital part of all successful scrap-recovery programs. Remember that by the end of 1952, the steel industry will be requiring more than five million tons more scrap than in 1950. For more steel, there must be more scrap.

"3 Make organized permanent salvage a top-management responsibility. A big burst of enthusiasm may solve the steel production rate right now, but the problem will be continuous. In less than three years the entire steel industry of American will have added more capacity than the entire capacity of Great Britain. This big increase will cause a continuous additional demand for scrap. If this country is to enjoy the benefits of additional steel production, the steel industry will need the co-operation of every top executive to see that scrap flows back promptly.

"4 Put scrap collection on a housekeeping basis. Besides increasing the steel supply, continuous scrap recovery of obsolete machines and equipment reduces taxes through inventory write-off, improves safety conditions, gives lowered insurance rates, and clears valuable space."

For many years The American Society of Mechanical Engineers has co-operated with other agencies in programs of salvage, waste disposal, and scrap movement. It has opened its meeting programs and its publications to appeals and to information, practical suggestions, and case histories on these important phases of our national economy. Today the stakes are higher than ever before. Let every engineer ask himself what he can do to help get out the scrap—and then do it.

For Better Teaching

MORE than twenty years ago the American Society for Engineering Education, then known as the Society for the Promotion of Engineering Education, organized, under the able and inspired leadership of Dean-Emeritus Harry P. Hammond, the first of its summer schools for teachers of engineering. The success of the first school was so marked that others were conducted in the years that followed; and from these schools hundreds of young men have received the inspiration by which their careers have been advanced.

Among the many objectives that were sought in establishing the summer schools, two stand out pre-eminently—the desire to broaden and deepen knowledge of subject matter, and to improve teaching methods.

Living together for periods of one to several weeks, listening to the best-qualified men talk on subject matter and methods, participating in discussion, enlarging the circle of professional friendship, relaxing in an atmosphere of informal shop talk, cannot fail to inspire and broaden the instructors and increase their usefulness to the engineering profession and education.

The instructors who can profit most from attendance at the summer schools are probably those least able to finance the expense. Although the best men will find ways of meeting the expense, means should be found to lighten this burden as much as possible in the interest of better teaching and a better profession.

CANADA'S INDUSTRIAL POTENTIAL

By THE RIGHT HONORABLE C. D. HOWE

MINISTER OF THE DEPARTMENT OF DEFENCE PRODUCTION, OTTAWA, CANADA. HONORARY MEMBER ASME

I APPRECIATE your invitation to attend this banquet and speak to the membership of The American Society of Mechanical Engineers. A few years ago your Society did me the honor to make me an Honorary Member, and I am happy in that association with you. Your President has sent me a program for this Semi-Annual meeting, and I would have liked to have heard some of the technical papers. However, when I left engineering sixteen years ago to be a Member of the Government, I decided that I must give up the practice of engineering, and I have kept to that decision as far as technical matters are concerned.

As Minister of Defence Production, I am well aware that the demand for engineers greatly exceeds the supply. This was true in time of peace, but the situation is much more serious in time of war. I suggest that engineering societies such as yours may well take steps to stimulate a greater interest among students in the secondary schools in favor of an engineering education. It seems to me that opportunities in this field exceed those in any other avenue leading to a useful and interesting life. A greater supply of trained engineers would be a splendid contribution to the development of North America.

I am glad that your Society is meeting in Toronto on this occasion. We Canadians have great respect for our engineering colleagues across the border. We envy you your access to a more diversified engineering experience than that open to most Canadian engineers. We welcome this opportunity of meeting and extending hospitality to some of your membership.

At the same time this meeting gives an opportunity for a group of leading American engineers to see for themsleves, at firsthand, what is going on in Canada. May I hasten to add, however, that even though some of the local citizens may try to persuade you otherwise, Toronto is not the whole of Canada. Other parts of the country deserve your attention, and I hope you will find time to do a little traveling while you are here.

Because of the presence of such a distinguished group of American citizens I intend to speak tonight about some aspects of the Canadian scene in which I believe our friends from south of the border have a particular interest at the present time. As a matter of fact, Mr. Chairman, I thought that my address might take the form of a "quiz" in which I would attempt to answer some of the questions that Americans frequently ask about Canada.

Obviously, of course, I had to make a selection. For there are many questions you might ask about which I have no special knowledge. And, to be perfectly frank, there are certain points about developments in Canada that I feel are important which can be discussed only if I ask myself the right questions.

Well, here are the questions:

What part is Canada playing in the Korean war?

What is Canada doing to defend herself and the northern part of North America?

To what extent is Canada co-operating with the North Atlantic Treaty Organization?

How big is the Canadian defense effort?

What is the Canadian attitude to compulsory military service?

Why aren't there as many controls in Canada as in the United States?

I am addressing my answers particularly to our American guests, but may I remark for their benefit that Canadians sometimes ask some of the same questions and may be equally interested in my answers!

CANADA IN THE KOREAN WAR

Let me then begin with the first question: What part is Canada playing in the Korean war?

When the United Nations sent out a call for free nations to send armed forces to stop aggression in Korea, Canada immediately sent three destroyers to Korea and sent a squadron of heavy transport planes to operate between America and Korea.

Canada then acted without delay to mobilize and place at the disposal of the United Nations a brigade of ten thousand combat troops. Recruiting began on Aug. 9, 1950, and the required strength was quickly reached. On Feb. 19 of this year one battalion of the famous Princess Patricia's Canadian Light Infantry went into action. The remainder of the brigade continued its training at Fort Lewis, Washington, and, in response to a request by the Unified Command, was sent to Korea. The entire Canadian brigade participated in the brilliant action which began a few weeks ago and which resulted in such a great victory for the forces of the United Nations.

These are the facts about our participation in the Korean war. Naturally enough, we are proud of the record of the Canadian forces. We think they have played an important and distinguished role. But Canadians do recognize that the brunt of the battle in Korea has fallen upon the American forces. It was the United States which gave leadership to the free nations when leadership was required and which has carried the major responsibility. We salute our American neighbors as brothers-in-arms.

DEFENSE OF CANADA

I come then to the second question: What is Canada doing to defend herself and the northern part of North America?

The defense of our immense territory by a population of fourteen million people presents a unique problem. We must depend upon mobility, for even if all our men of military age are pressed into service, we could not hope to defend our sea coasts and our centers of population by any static defense. Therefore our defense planning in Canada must emphasize air power and sea power; air power to focus the defense on the point of attack wherever it may be, and sea power to protect our coasts and our trade routes. The normal backbone of our active service infantry force is an air-borne brigade, highly trained and specially equipped for warfare in the northland, that can be moved with all speed and dropped by parachute, if

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necessary, wherever an attack may occur. Our static defense includes fortifications for our coastal cities and anti-aircraft protection for our vital points. Our permanent force is backed up by a reserve army organized as a skeleton of six divisions, well-equipped and ready for mobilization on a reasonable notice.

In the event of war, we may expect air attacks from Russia. To meet that possibility our armed services are working in close co-operation with those of the United States. A screen of radar stations is being built, connected by a network of communications and backed by squadrons of fighters, strategically placed. The Canadian and American chains will be linked together to form a single system. One quarter of the system will be in Canada and will be built by Canada. To supplement this air defense, we are modernizing our heavy anti-aircraft guns to protect our vital points against bombing. We must also be prepared for the possibility of air-borne troops being landed in North America. As I have stated, we have specially trained air-borne troops to meet such an attack.

Our navy is being brought up to a strength of about one hundred ships, including one aircraft carrier, two cruisers, and a considerable number of destroyers and smaller escort vessels. We are building a fleet of well-armed high-speed escort vessels to cope with the latest edition of the Russian submarine. Our navy is expanding its air support to protect the approaches to our principal harbors.

That, in brief, is our approach to the defense of Canada and North America should an attack be launched directly against our home territory. We are not neglecting these home defenses but neither are we relying upon them alone for our safety. Just as we supported without hesitation the police action by the United Nations in Korea, so have we promoted and supported the North Atlantic Treaty Organization.

CANADA'S CO-OPERATION WITH NATO

This brings me to the third question: To what extent is Canada co-operating with NATO?

As I have said, we in Canada look upon collective measures for defense by the North Atlantic Treaty Organization as a part of the defense of Canada. We are not isolationists and never have been. It is the view of the Canadian Government that the vital area of global defense is in Western Europe and we have acted accordingly.

Let me summarize briefly the practical steps we in Canada have taken in support of the North Atlantic Treaty Organization. In 1949 Canada offered to train army officers and aircrew for other NATO countries. Arrangements were worked out under which army officers and aircrew for Belgium, France, Italy, The Netherlands, Norway, and the United Kingdom are being trained in this country. The total number of aircrew to be trained now stands at 1400 per year.

Last year we offered to NATO armament and equipment of United Kingdom type for a division. This was accepted and shipped last year to The Netherlands. Armament and equipment for a second division was offered in February of this year, and formal transfer to Belgium took place in March. We have agreed to send armament and equipment for a third division to Italy. Further transfers will be arranged as soon as replacement of United States type can be obtained.

In addition, we are building munitions for NATO countries, which include early-warning radar sets, walkie-talkie sets, and several types of heavy artillery. Serious consideration is being given to other NATO requests, particularly those munitions that fit in with our Canadian production program.

But Canada recognizes that equipment is not enough. We are making our contribution in men to the defense of Western Europe. As I have already said, we are strengthening the Canadian Navy which has a vital role to play not only in the defense of harbors and coasts but also in guarding the life line of shipping which stretches across the Atlantic Ocean.

Our most important contribution will be in the air. One Canadian squadron is already undergoing training in England. Within the near future this force will become a wing of three squadrons. Ultimately Canada will have in the Integrated Force an air division of eleven squadrons at full fighting strength equipped with Canadian-built planes.

Finally, Canada is now recruiting a brigade of the Canadian Army which will take its place in the Integrated Force of NATO. The response to the recruiting campaign has been excellent and the quota will soon be filled.

SIZE OF CANADIAN DEFENSE EFFORT

That, in brief, is what we have done and are doing as our part in NATO. What we may have to do in the future I do not know. But I think it is fair to say that Canada is taking its treaty obligations seriously and is doing its part to make this alliance of peace-loving nations a mighty bulwark against the rushing tide of aggression.

HOW BIG IS THE CANADIAN DEFENSE EFFORT?

If I had the time or the inclination I could present to you an elaborate set of figures comparing defense expenditures in Canada with those in the United States. But I am going to leave such an exercise to the statisticians. Besides, I sometimes think these comparisons do more harm than good. There are elements in the defensive strength of any country that cannot be reckoned in the simple arithmetic of government expenditures.

Canada has never shirked its responsibilities. We fully expect to carry a fair share of the sacrifices and costs of defense. On a per capita basis we shall probably carry more than many of our allies.

What we are trying to do here in Canada is to make the most effective use that can be made of the manpower and resources at our disposal. That is the guiding principle behind the Canadian defense effort. We are concentrating our efforts, as far as possible, upon doing those things which will add maximum strength to the defenses of North America, of NATO, and of the United Nations. That is the only policy that makes sense for Canada or, for that matter, for any country threatened with aggression in the modern world.

Canada's defense effort is a many-sided effort. I have spoken of military plans and accomplishments in Korea in the defense of North America and in co-operation with NATO.

We are bringing into production the great variety of modern weapons needed for the armed services and for their support. Our emphasis upon air defense has made it necessary for us to build extensive facilities for the training of aircrew, not only for the Royal Canadian Air Force but also for the airmen of other NATO countries. In the field of aircraft construction we are building two types of jet fighter planes that we believe are the most efficient being built anywhere. We are also producing trainer planes, some of which will be used in the United States. We are coming into production with a jet engine suitable for our fighter planes and with a radial engine that will power our trainer planes. We have a very large radar program in hand. Our shipyards are busy building fast escort vessels and mine sweepers. Our largest gun plant of the last war has a program in hand of naval guns and field artillery, partly for the United States. Our six arsenals are turning out small arms and ammunition.

But there is another side to Canada's defense effort. In our view, preparedness is not simply a matter of turning out, as quickly as possible, the maximum quantity of weapons and

ammunition, or of putting the maximum number of men under arms. It is something far bigger and far more difficult.

The object of these preparations is not war. Rather it is to build up the collective strength of the free world so that the potential aggressor will not risk war. There must be available the forces and the material to withstand the shock of sudden and early attack. There must also be the reserves of power upon which to depend in the struggle for victory.

In Canada therefore we are concentrating a great deal of effort upon building up our fundamental economic strength. The evidence of this is not to be found, in the main, in government expenditures upon defense. Rather it is to be found in the plans and projects of basic Canadian industry. For example, whereas Government expenditure for defense production will total about one billion dollars this fiscal year, investment by private industry in productive facilities vital to the defense effort of the free world will be about one billion five hundred million dollars. But whether these large amounts appear in government expenditures or in the investment plans of Canadian industry, they represent a demand upon Canadian power and resources. That is one reason why I do not think that the size of our contribution to the defense of the free world or the contribution of any other country is fully represented by defense expenditures.

It is perhaps hardly necessary for me to emphasize to a group of engineers the importance to the free world of an increase in the output of base metals or steel or petroleum or hydro power. Here in Canada we rate projects designed for these purposes on a par with defense industries. And it is fortunate for the free world that here in Canada the potentialities for expansion of these critical materials are so favorable. I shudder to think what the prospect would be if there did not exist in Canada, ready for development, such large deposits of iron ore, uranium, copper, nickel, lead, and zinc, and such large untapped reserves of water power.

COMPULSORY MILITARY SERVICE

My self-appointed "quiz" has only two questions to go: First, what is the Canadian attitude to compulsory military service?

Perhaps the chief source of criticism of Canada by Americans is that we do not have a system of compulsory military service. That is quite true but because we do no have compulsory military service does not mean that we are holding back in our preparedness effort. As I told some American friends in Chicago some weeks ago, the facts are quite to the contrary. In the opinion of the Canadian Government, Canada's defense effort would be weakened instead of strengthened by an attempt to introduce conscription at the present time. What I ask you to remember is that, when in the past the need arose for men to fight for freedom, Canada was not found wanting, either in quality or in quantity. Some time ago our Prime Minister, the Right Honorable Louis St. Laurent, placed his views before the House of Commons on this problem of compulsory military service. I cannot do better than quote him:

". . . we have been endeavoring to obtain the best possible information as to the most effective way in which our contribution can be made. So far there has been brought to my attention nothing that would indicate that the institution of national selective service at this time would be beneficial. On the contrary, the information we have obtained is that it would hamper what is being done at this moment. Now, that does not mean that the situation cannot change, and it does not mean that if and when it does change there will not be changes in the manner in which our resources will be contributed to this pool of international strength. But those changes will not be recommended by this government on any sentimental grounds because of any appeals on a racial or religious basis, but on their actual effective value to the joint strength of the combined forces of the North Atlantic alliance."

CONTROLS IN CANADA

One final question and that relates to controls in Canada and the United States. Some of you may have wondered why there seem to be fewer controls here in Canada than in the United States and drawn the inference that the defense effort is not impinging so sharply upon the Canadian economy as it is upon the United States economy.

This is a case in which, to some extent at least, appearances are deceiving. Here in Canada the Federal Government has been employing different methods of influencing the economy, not necessarily better methods than those employed in the United States but, in our opinion, better adapted to Canadian circumstances.

In fact, some of the Canadian controls are more restrictive than those in the United States. Our consumer credit controls are more comprehensive, require a higher down payment and a shorter period of repayment than those in effect south of the line. Our banks are co-operating in a stricter credit policy.

We have also attempted in the federal budget to strike at the roots of the inflationary problem, by following a pay-as-you-go policy and by tax changes specifically designed to discourage consumer spending and less essential business investment. Some of you may have heard of our plan of deferred depreciation by which depreciation is deferred on a wide range of capital investment for a period of four years. Canada is the first country to experiment with such a plan and the results to date seem to be good.

As to scarce materials, our controls differ from those in the United States but they are designed for much the same purposes and will, I believe, produce at least as good results. Wherever possible, however, we try to keep our materials controlled on an informal basis. This is possible in Canada because of the comparatively few producers involved.

It has not been considered advisable to establish a system of price controls in Canada. For the time being we are relying on more fundamental anti-inflationary policies, and those policies are working. Prices in Canada, like prices in the United States, are much more stable than they were a few months ago. We have not had spectacular price-cutting wars like those in New York, but some sellers in Canada have found, I believe, that over-accumulation of inventories has not paid off. I hope we shall not have to impose widespread price controls in Canada, and if people are sensible and avoid hysteria, I think that we can, with some extra productive effort on everyone's part, avoid them. Nevertheless, the power to control prices is ready at hand should the need arise.

In closing, I suggest to you, Mr. Chairman, that Canada is a good neighbor to the United States in time of peace and a sturdy ally in time of danger. It is our purpose in Canada to make the best possible use of the resources with which we are endowed. We are pressing ahead on every front—to find and develop our mineral resources, to make the most efficient use of our forests and streams, and to expand the output of our farms and fisheries. Nor are we neglecting industry. The long-run trend toward diversification of the Canadian economy continues at an accelerated rate.

But these material accomplishments are by no means the whole story. We Canadians take more satisfaction, I believe, from the fact that we pay our bills, pull our weight, and preserve our national integrity.

SAND RECLAMATION *at the* EDDYSTONE PLANT

By KARL S. HOWARD[1] and CLYDE B. JENNI[2]

INTRODUCTION

SAND[3] for molding and coremaking is one of the most important materials used in steel-foundry operations. The use of new sand in foundries producing large steel castings varies from 1 to over 2 tons of sand per ton of castings. Large tonnages of new sand must be purchased continuously to maintain the quality of the molding sand.

It is obvious that at any given rate of foundry operation, the quantity of refuse sand to be disposed of must be equal in amount to the new sand purchased Such a practice must of necessity be wasteful, in addition to becoming an increasingly costly operation. In most instances, foundries were built in isolated locations which provided large areas for the disposal of the refuse sand at very small cost. As time passed, however, the areas around the plants were built up, and off-site locations for the disposal of the refuse sand became necessary. The disposal problem thus becomes an important factor, and handling costs increase greatly, particularly where rail facilities must be used.

When large quantities of new sand are used, adequate facilities must be provided for storage during the winter months when sand production may be curtailed. New sand costs are increased at the pits in the winter months, and sand, which arrives in the cars frozen, adds greatly to unloading costs. In some locations sufficient storage for the total sand requirements for the winter months may be necessary since the sand pits are not operated during the period because of adverse weather conditions.

The purchase of new sand in quantity also becomes an important cost item. While the sand itself is relatively cheap at the point of origin, transportation and handling costs frequently exceed the cost of the sand. A reduction in the use of new sand is therefore desirable for economical foundry operation.

Two pertinent questions can be raised: (1) Is it possible to recondition used foundry sand so that it will be equivalent in its characteristics to new sand? (2) If so, will such an operation be profitable?

Before answering these questions consideration should be given to the characteristics of new sand and used sand, in order that the objectives of a reclamation program can be established.

ORIGIN OF MOLDING SANDS

Sands used for steel-foundry operation are silica sands occurring in natural deposits in various parts of the country. Among the better known deposits are: Ottawa sand found in central Illinois, and southern New Jersey sand. The Ottawa sand had its origin in the St. Peter sandstone and is quite pure (99 per cent plus). The New Jersey sand is equally pure. The crude sand contains some clay. Another characteristic of the Ottawa sand is the rounded shape of the sand grains. The deposits are usually subsurface and contain small quantities of silt or clay. The New Jersey sands have a subangular to rounded shape.

Figs. 1 and 2 show typical New Jersey sands with their subangular-shaped grains.

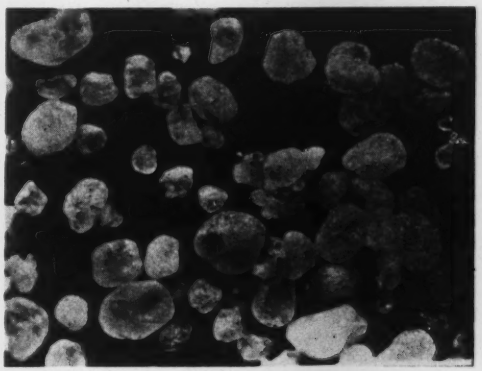

FIG. 1 NEW DORCHESTER SAND

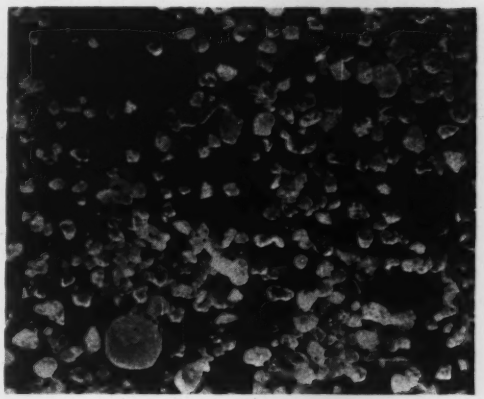

FIG. 2 NEW GRADE "C" SAND

PREPARATION OF MOLDING AND CORE SANDS

In the production of molds and cores in the steel foundry the newly purchased sands are compounded with various binders

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[3] It is common usage in the foundry industry to call the mixture of materials used for making a mold as "sand." This can be divided into core sand, dry sand, green sand, and so forth.

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and other materials to impart the necessary strength and workability characteristics. Fireclay, bentonite, lignins, cereal binders, oils, starches, resins, and other materials are commonly used in compounding suitable mold and core sands. One of the chief functions of most of these materials is to serve as a binder in holding the sand grains together to produce the mold or the core. The sand grains must be mixed intimately with these materials so that the grain surfaces become coated, in order that the sand mix may function most efficiently in the molding or coremaking process. The various binders mentioned are used to impart various characteristics to the sand mixes—such as, workability or ease of mixing, flowability or ease of compacting to form the mold or core, green strength or ability to maintain the shape of the mold or core, dry strength or ability to withstand handling, hot strength or ability to withstand high temperatures and metal flow, mold collapsibility to permit shrinkage of the casting during solidification, and thus to avoid hot-tearing.

In coremaking, the cores are baked in ovens at 350–500 F to develop the desired properties. Some binders used, such as certain resins, are thermal-setting, while certain oils develop their binding properties by oxidation or polymerization reactions. In any case, in core-baking, the compounded sands have undergone pronounced changes, the binders held mechanically on the sand grains having been changed to a tenacious film material with entirely different properties. This coating may or may not be water-soluble.

DETERIORATION OF SANDS IN USE

When molten steel is poured into the molds, the compounded mold and core sands in contact with the molten steel undergo mechanical and chemical changes. The sands in the molds and cores below the actual contact area are also affected by the increase in temperature. Decomposition, distillation, and condensation, and charring reactions occur in varying degrees among the cereal binders, lignins, starches, resins, and oils which change the surface condition of the sand grains materially. This change in properties of the compounded sands is sufficient to make it undesirable to re-use this sand on the mold and core face of subsequent molds in contact with the molten steel.

One of the most important effects resulting from the contact of the compounded mold or core sand with molten steel is the coating of the sand grains with a firmly adhering film of clay binder and carbonaceous matter. At the temperature of molten steel, the water of crystallization of the clay compounds is driven off and the clay or bentonite film on the grains has distinctly different properties from the original binder. The carbonaceous matter results from the decomposition of organic compounds present in the mix.

If molding sands which have been exposed to the molten steel are re-used, the bonding with clays or oil is less effective. The coating on the sand grains also becomes a cumulative effect if the sand is further re-used, the sand, therefore, becoming progressively poorer in quality for mold or core facings.

These sands are also contaminated with metallic iron and iron oxides as a result of their contact with the molten steel and from the cleaning of the castings. Further contamination results from silica flour and clays used as binders. All of these foreign materials lower the permeability of the sand mix which in turn hinders the escape of mold gases and may contribute to casting defects. These materials also may form low-melting-point compounds which lower the sintering point of the sand mixture and thus contribute to "burnt-on" sand and metal penetration. The presence of these materials may also affect the workability of the sand adversely to the extent that improper ramming results with its attendant evils of scabs, drops, buckles.

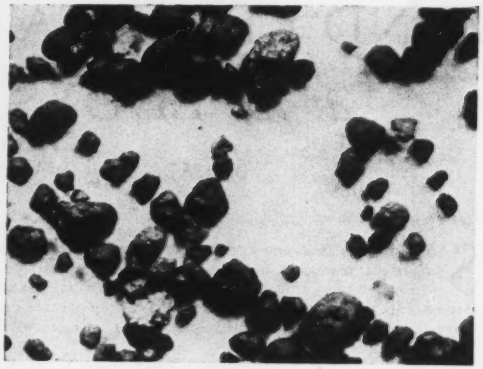

FIG. 3 USED SAND

Fig. 3 shows the coating on the grains of used sand. A comparison with Figs. 1 and 2 of the new sands shows the vast difference of the surface conditions of new and used sand grains. One can easily understand why the re-use of the sand as shown in Fig. 3, would offer difficulties when compounded in the same way as the sand shown in Figs. 1 and 2.

The sand grains which are principally quartz, suffer little change when used except for the coating phenomena previously mentioned. Any treatment therefore which will remove the coating completely from the grains will restore the sand grains to their former usefulness. Such a treated sand becomes the equivalent of new sand in every respect.

METHODS OF RECLAMATION

There are several systems of reclamation possible: (1) dry reclamation, (2) wet reclamation, (3) thermal reclamation, and (4) a combination of wet and thermal reclamation.

Dry reclamation consists of the removal of fines such as silica flour and clays by air separation. A certain degree of classification is accomplished either by screens or by air separation. Dry reclamation has very little effect on the coating on the grains, since this film is tenacious, and a pronounced scouring or scrubbing action is required to free the grains from the coating. The removal of the fines increases the permeability of the sand and may raise the sintering point, but fundamentally the used sand has not been restored to the quality of new sand.

The wet method of reclamation consists of mixing the sand with water with a mechanical scrubbing action. A considerable portion of the coating on the sand grains may be removed, depending upon the efficiency of the scrubbing. The wet scrubbing is effective in the removal of clay films but is not totally effective in the removal of the carbonaceous matter. The product of wet reclamation usually has a gray appearance, some grains possessing a luster and others a dull appearance showing some coating.

The thermal method of reclamation consists of heating the used sand at temperatures of 1200–1500 F. This treatment completely removes the carbonaceous matter. Part of the clay coating may be removed by the abrasive action in the roasting furnace. The efficiency of the removal of the clay coating is dependent upon the type of clay used in the sand mixes and the scrubbing action received in the heating unit. Western bentonite films are more readily removed than fire-clay films. In general, however, the sand grains are not cleaned completely,

and erratic results may be obtained, especially if fire clay is used. Fig. 4 shows a fire-clay-bonded sand which was given a thermal treatment; the grains still contain some coating.

Since wet-scrubbing is effective in the removal of the clay films, and thermal treatment removes the carbonaceous matter, a combination of the two methods should produce excellent results. Fig. 5 shows a fire-clay-bonded sand which was treated by wet-scrubbing and heating. The grains possess their original luster and are free from practically all of the coating. This sand has been restored so that it is equivalent to new sand. Sands which have been reclaimed by this method will show a reddish-yellow hue because of a slight iron stain which has no harmful effects.

Several attempts had been made by our company in the past to reclaim the used sand. In the early 1920's, at the Commonwealth Plant in Granite City, Ill., equipment was installed to wash and classify the sand in conjunction with the hydraulic-cleaning of the castings. This installation was later discontinued along with the hydraulic-cleaning process. A contributing factor was the excessive cost of maintaining the equipment, particularly the centrifugal driers used to dewater the reclaimed sand. The reclaimed sand, however, was used for a great many years in the molding operations.

In the Armor Plant, built during World War II at Madison, Ill., for the Defense Plant Corporation, to manufacture cast armor for the tank program, a Link-Belt sand-reclaiming plant was installed. This was a horizontal rotary kiln for thermally treating the sand, and a similar unit for cooling it. In this operation the carbonaceous coating was burned off, and the adhering bentonite calcined. The sand was then put through a Beardsley & Piper Mill to scrub off the calcined clay. This mill was equipped with an exhaust fan which drew out the clay fines. The sand reclaimed was gray in color but was used successfully in the molding operations. The greatest difficulty encountered in this installation was in maintaining the refractory lining in the high-temperature kiln. The results obtained from this installation were not conclusive as the plant was shut down after 9 months of operation, owing to the curtailment of the tank-building program.

In specialized foundries it has been possible to use successfully any one of these methods depending upon the class of work made. The Eddystone Plant produces a broad range in size and weight of castings varying from lightweight railroad specialties to the heaviest of miscellaneous castings. Consequently, all types of molding media such as green sand, dry sand, and all-core molds are used. Our approach to the reclamation problem, therefore, was to produce a product which could be used interchangeably with new sand for both core and mold facings.

After extensive laboratory experiments, the combined wet and thermal process was adopted as offering the best possibility for meeting our requirements. It is effective in removing the coating resulting from the use of inorganic and organic binders. This is an important consideration since a trend is developing in the industry to the use of various resin binders which in many instances are not water-soluble.

COMPARISON OF NEW AND RECLAIMED SANDS

The sand used at Eddystone comes from the South Jersey sand pits. Two grades are purchased in approximately equal quantities, Dorchester grade, which is a crude sand, and grade "C" which is washed and classified at the source. Typical screen analyses of these sands and the equivalent reclaimed products are given in Table 1.

Since sands of two different grain sizes are used in about equal quantity, a further requirement for the reclamation process is that the reclaimed sand be separated into two portions

FIG. 4 CLAY-BONDED SAND AFTER THERMAL TREATMENT

FIG. 5 CLAY-BONDED SAND AFTER COMBINED WET AND THERMAL TREATMENT

of grain size and grain distribution similar to that of the two new sands purchased. The physical setup of our sand storage bins and sandhandling equipment made it mandatory that the new Dorchester sand and the reclaimed sand, corresponding to this grade, be stored in the same bin. Likewise, the new grade "C" washed sand and the portion of the reclaimed sand, corresponding to this grade, must be stored together. Fig. 6

TABLE 1 SCREEN ANALYSES AND EQUIVALENT RECLAIMED PRODUCTS. SOUTH JERSEY SANDS

	Dorchester sand		Grade "C" sand	
Screen no.	Purchased	Reclaimed	Purchased	Reclaimed
6	...	...	...	...
12	0.2	0.4	...	...
20	6.6	8.4	Tr	Tr
30	21.4	22.2	0.2	0.8
40	25.6	25.8	1.8	6.4
50	25.8	25.6	13.2	18.6
70	14.2	14.4	38.8	36.8
100	4.4	2.8	35.6	30.8
140	0.8	0.2	8.2	5.4
200	0.2	Tr	1.2	0.6
270	Tr	Tr	0.4	0.4
Pan	Tr	Tr	0.4	0.2
Total	99.2	99.8	99.8	100.0
AFA clay	1.0		0.2	100.0

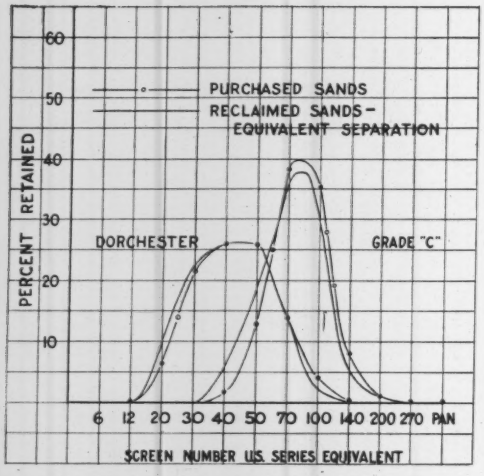

FIG. 6 GRAIN DISTRIBUTION, NEW AND RECLAIMED SANDS

shows grain-distribution curves of the two purchased sands and the reclaimed sand, separated into the two equivalent grain sizes. The curves on the left are the Dorchester sand and its equivalent reclaimed-sand portion, the curves on the right, the grade "C" washed sand and the equivalent reclaimed-sand portion. These curves indicate that the reclaimed sands can be stored indiscriminately with the new sands and used interchangeably in our sand formulation. This has been demonstrated by our plant operation on this basis over the past 18 months.

DESCRIPTION OF THE PLANT

The plant was designed for 100 net tons per day output and, when operated continuously 7 days per week, has a capacity of 3000 net tons per month. In service, the plant has operated at the rate of 110/115 tons per day for extended periods.

Work was started in 1947, and the plant was put in operation in November, 1948.

The cost of the installation complete, including the necessary building, was $130,675.20. It is housed in an L-shaped steel building having a floor area of 2500 sq ft.

All of the equipment used in this installation is standard and has been used in the mining and allied industries for many years. Their service characteristics and operating results are well known so that the hazards usually associated with new or experimental plants of this type were minimized greatly.

The flow of the sand through the plant is shown in the schematic flow-sheet diagram, Fig. 7.

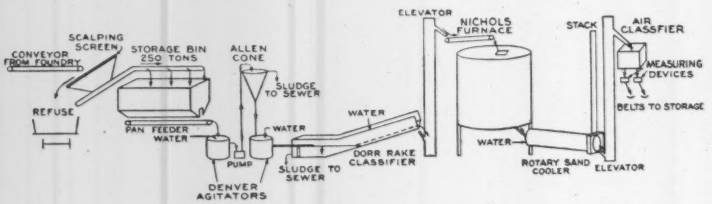

FIG. 7 SCHEMATIC FLOW SHEET

The sand is received from the foundry by belt conveyer which discharges on a scalping screen for removing the oversize material and refuse, such as, paper, wood chips, asbestos, packing, lumps of sand, and so forth, from the sand. The storage bin is provided for Saturday and Sunday operation of the reclaiming plant as the foundry operates on only a 5-day schedule. This bin has a capacity of 250 tons which is sufficient for 2 days' operation. It has a hopper bottom over a 24-in. pan conveyer running full length for feeding the sand. The rate of feed is governed by an adjustable gate at the discharge end and by the speed of the pan.

The pan feeder discharges into a Denver agitator where sufficient water is added to make a concentration of about 50 per cent solids. These agitators are 5 ft diam × 5 ft high and, in the center, have a vertical pipe extending downward two thirds of the height of the tank. Below the bottom of the pipe is a 15-in-diam three-bladed propeller driven by a vertical shaft. The sand and water are fed into the pipe; the discharge from the agitator is near the top of the outer shell. The circulation is quite rapid, and the sand receives a thorough scrubbing by impinging on a wear plate beneath the propeller.

The sand and water from the agitator are pumped by a Wilfley pump into an Allen cone overhead. This is a conical tank 7 ft 2 in. diam × 7 ft 9 in. high, provided with a float-controlled discharge valve in the bottom. As the sand settles, it is discharged from the bottom, while the sludge and dirty water overflow a circular weir at the top. The use of an Allen cone at this point relieves the system of a large amount of sludge after the initial scrubbing, and results in more efficient functioning of the subsequent operations.

The discharge from the Allen cone is into a second Denver agitator where clean water is added to bring the concentration to 50 per cent solids. Here the sand receives a second scrubbing.

The Dorr rake classifier receives the sand and water from the second Denver agitator. It is type DSFR, 3 ft wide × 21 ft 8 in. long with a 20-ft deck extension and deep pusher. The trough of the classifier is set on a slope of $2^1/_2$ in. per ft and receives the sand and water at the lower end. The action of the pushers, which operate at 18 strokes per min, moves the sand up the incline by their reciprocating motion. Clean water in volume is introduced about midway of the incline section of the classifier to "back wash" the sand. The function of the classifier is to separate the remaining sludge and fines from the sand and to some extent dewater it. The sand is discharged at the upper end of the classifier with 18 to 20 per cent water content into an elevator which conveys the sand to the top of the Nichols furnace.

It may be desirable to install a centrifuge at this point to reduce the percentage of water in the sand to approximately 5 per cent before entering the Nichols furnace. This will result in a saving in fuel used in the Nichols furnace which, however, will be offset somewhat by the investment, power, and repairs incidental to the operation of the centrifuge.

The Nichols furnace is a wedge multiple hearth having seven hearths with an area of 881 sq ft. The outside diameter of the steel shell of the furnace is 16 ft 9 in. and has a brick lining $13^1/_2$ in. thick, consisting of $4^1/_2$ in. of firebrick and 9 in. of insulation. The sand enters the center of the top hearth, and its movement through the furnace is accomplished by a rotating center shaft attached to which are two rabble

arms for each hearth. Mounted on each rabble are several plows equally spaced and set at such an angle that as they move through the sand they plow the sand inwardly on one hearth and outwardly on the next lower hearth. The top hearths remove the moisture from the sand, the center hearths burn the combustible material from the sand grains, and the bottom hearths cool the sand. The center hearths operate at a temperature of 1350–1450 F, and the sand is discharged from the furnace at approximately 900 F. The furnace is fired with bunker C oil, using six No. 782 Hauck proportioning-type oil burners. The burners are located on the third and fifth hearths.

A horizontally revolving barrel set at a slight angle toward the discharge end receives the hot sand from the Nichols furnace. This barrel is 5 ft diam × 14 ft 9 in. long and revolves at 12 rpm. Fine spray nozzles are installed at the inlet end of the barrel which are thermostatically controlled in steps by the temperature of the sand at the discharge end of the barrel. A series of horizontal lifting shelves inwardly projecting pick up the sand and discharge it on rotation into the center of the barrel thereby intimately mixing the sand and water. Calculations indicated that approximately 2 gpm of water are required to reduce the temperature of the sand from 900 F to 250 F at the rated capacity of 8000 lb of sand per hr. The housing around the discharge end of the barrel is provided with a stack through the building roof to discharge the steam generated in the barrel. In operation, the sand from the cooler can be maintained at 180 F without encountering too much recondensation in the stack.

The cooler discharges into an elevator which conveys the sand to an American Air Filter fines cascade for separating the reclaimed product into the two basic sands of the screen classification originally purchased. These are shown in Fig. 6 as described previously.

It has been found in operation that the actions of the cooler and fines cascade remove a large percentage of the ash which is left in the grains as a result of the burning operation in the Nichols furnace.

The measuring devices shown between the air classifier and belts, conveying the sands back to the storage bins, consist of a box of known capacity having a hinged and counterweighted bottom which opens when full to discharge the load. A Veeder counter records the number of times the box is filled. From this information the tonnage of sand reclaimed can be calculated. It has been found that this type of measuring device is accurate enough for all practical purposes.

The loss through the reclamation plant can be calculated, roughly, from the size of the opening in the storage bin and the speed of the pan feeder, as compared with the reading obtained from the measuring devices after the air classifier. It indicates approximately a 20 per cent loss which consists of the clay, silica flour, binders, carbonaceous matter, fines, and water removed from the refuse sand in the reclamation process.

OPERATING COSTS AND RESULTS

During the calendar year the Eddystone Plant produced 20,720 net tons of good castings. The total amount of molding sand used was 48,162 net tons, which is 2.32 net tons of sand per ton of castings. The division of the total sand used between new sand purchased and reclaimed sand is given in Table 2.

The results given in Table 2 indicate that 44.7 per cent of the sand used in the molding operations during the year was new sand purchased. There are unavoidable losses of sand in the foundry as well as certain amounts that become contaminated to such an extent that it is not desirable to reclaim. These losses must be made up by the purchase of new sand to maintain workable inventories.

The general belief seems to be that in the use of a reclaiming plant, the sands will get progressively finer with continued operation. Our experience indicates that this is not true. It will be noted that 60.8 per cent of the grade "C" sand used by the foundry was purchased, while the corresponding figure for the Dorchester sand was 25.7 per cent. The finer-screen classifications tend to be removed by the dust-collecting systems used extensively in milling, shakeout, and sand handling equipment, as well as in the reclaiming plant itself.

TABLE 2 SAND USED IN EDDYSTONE PLANT PRODUCTION

	Purchased, net tons	Reclaimed, net tons	Total, net tons	Per cent new
Dorchester sand	5679	16394	22073	25.7
Grade "C" sand	15865	10224	26089	60.8
Total	21544	26618	48162	44.7

During the calendar year there were 31,203 net tons of sand reclaimed by the plant of which 18,789 net tons was of the Dorchester classification and 12,414 net tons of the grade "C" classification. The difference of 4585 net tons between the 26,618 net tons reclaimed sand used and the 31,203 net tons produced by the reclaiming plant is in inventory adjustment at the beginning and end of the year.

The operating results for the year, given in Table 3, show the cost per net ton of sand reclaimed.

TABLE 3 OPERATING RESULTS OF RECLAMATION PLANT

	Per net ton	
Actual labor including overtime premium and service labor	$ .48	
Material, fuel oil used	.58	
Supplies	.05	
Total	$1.11	$1.11
Distributed general service charges:		
Direct repairs	.20	
Power	.14	
Plant general	.26	
Depreciation and property taxes	.19	
Total distributed general service charges	$ .79	$ .79
Total cost per net ton sand reclaimed		$1.90

Based on the figures in Table 3, the estimated saving for the year 1949 as a result of the operation of the reclaiming plant as compared with the cost had an equivalent tonnage of sand been purchased is given in Table 4.

The results in Table 4 indicate a saving of $1.56 per net ton of sand reclaimed, or a total of $48,760.50 for the year. To these figures very properly can be added 25 cents per ton for drying the new sand when received and 20 cents per ton for disposal of an equal tonnage of refuse sand both of which are not included in the foregoing. This is an additional saving of 45 cents to be added to the $1.56, or a total saving of $2.01 per net ton. These costs add $14,041.35 to the annual saving, making a total of $62,801.85 for the year. This represents an annual return of nearly 50 per cent on the investment of $130,075 in the plant.

There are additional savings which are hard to compute in dollars and cents. The sand reclaimed represents six hundred 50-ton railroad cars which would have had to be handled in and out of the plant during the year had the sand been purchased. In addition, an equal number of cars of refuse sand would have been moved from the foundry to the dumping area.

CONCLUSIONS

1 Refuse sand, resulting from steel-foundry operations, can be reclaimed by combined water-scrubbing and thermal treatment so that the product is equivalent to new sand.

2 The costs obtained indicate that it is economically attractive to install plants of this type in the steel-foundry industry.

TABLE 4 COMPARISON OF COSTS OF RECLAIMED AND NEW SAND AND SAVINGS

	Grade "C" sand			Dorchester sand			
	Net tons	Price	Amount	Net tons	Price	Amount	Total
New sand delivered and unloaded	12414	$3.83	$47,545.62	31,203	$3.23	$60,688.47	$108,234.09
Reclaimed sand in bin	12414	$1.90	$23,586.60	31,203	$1.90	$35,886.99	$ 59,473.59
Estimated savings		$1.93	$23,959.02		$1.33	$24,801.48	$ 48,760.50
Estimated saving per net ton sand reclaimed							$1.56

3 This method of reclamation is effective, regardless of the combination of binders and other additive materials used in the mold or core sand formulation.

4 Operation over an extensive period of time has shown that the reclaimed sand can be divided into two sands of grain-distribution characteristics corresponding to those of the two purchased sands. The reclaimed sands are stored in the same bins as the purchased sands and are used interchangeably with the new sand in compounding mold and core sand mixes with no change in formulation.

5 The continued period of operation has shown no change in the grain characteristics of the sands reclaimed as compared with the new sands purchased.

6 The foundry refuse-disposal problem has been alleviated greatly by the installation of this plant.

7 Sand storage for winter operations has been reduced to a minimum.

LONG-TERM BUSINESS OUTLOOK[1]

By RALPH E. FREEMAN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PRICES in the United States will continue to rise for the duration of the rearmament period, and thereafter, during most years of the next decade. This is the opinion of Professor Slichter of Harvard expressed in a recently published book, "What's Ahead for American Business."[2] He gives two main reasons for this opinion. The first is the likelihood that labor unions will raise money wages faster than the increase in output per man-hour. The second is the probability that large government expenditures will produce frequent deficits in the federal budget.

This rise in prices will, according to Professor Slichter, be relatively steady; and the economy as a whole will be more stable in the future than it has been in the past. This prospect for stability can be attributed to many factors. Businessmen are more sophisticated than they were and less inclined to behave in ways that aggravate the ups and downs of business. Various institutional developments make for a stable economy—unemployment compensation, pension plans, deposit insurance, the fact that government securities now constitute a large percentage of bank assets, and the stabilizing influence of federal fiscal policy.

The author is concerned in the main with the long-run influences that are likely to mold the economy in the "foreseeable future." In chapter 2, however, he discusses the current defense program and what is likely to happen to government expenditures, employment, production, price controls, profits, and other matters of current interest. He comes to the conclusion that this rearmament period will not materially change the long-run trends discussed in other chapters. It will strengthen and accelerate developments which would have occurred in the absence of the present emergency.

Professor Slichter emphasizes the importance of recent shifts in the attitudes and preferences of the American people. "The essential change in ideas may be put in one sentence: It is the abandonment of the view that the economy is self-regulating and that it is a mistake for the government to interfere with its operation." The author then goes on to say that the traditional view of "hands off" has been replaced by the view that the economy needs to be regulated in many respects and that the government must assume some responsibility for regulating it. "This new philosophy accepts a new fixed point of adjustment. That point is 'full employment.' The view is that production, prices, and incomes should be adjusted to full employment."

This book, though relatively short, ranges over quite a wide field. It deals with trends in technological research, trade-union membership and policy, the growing dependence of the United States on imported raw materials, the continued importance of the demand for capital goods, the broadening ownership of corporate industry, and many other interesting and important topics.

Separate chapters are devoted to "The Position of the United States in the World Economy" and "The Capacity of Our Economy to Grow." In the former there is a plea for the lowering of import barriers. "The most practical way for the United States to help the rest of the world, and at the same time help itself, is to buy goods in huge quantities." In the second of these chapters Professor Slichter states that the prospects of rapid expansion are excellent. Various conditions contributing to such expansion are discussed—the number of workers available, the supply of savings, and the adequacy of money demand. The author does not share the fears expressed by some economists that "secular stagnation" is threatened because of a dearth of investment opportunities.

In the last chapter on the future organization of the economy Professor Slichter makes a strong claim for the material and moral superiority of American institutions. This superiority is attributable, he believes, to the fact that these institutions produce a balanced division of power and to the extraordinary opportunities and responsibilities they give to the individual. He believes that the American system of decentralized decision

(Continued on page 650)

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "What's Ahead for American Business," by Sumner H. Slichter, Little, Brown and Company, Boston, 1951 ($2.75, 205 pages).

NEOPRENE APPLICATIONS *in* ENGINEERING DESIGN

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INTRODUCTION

NEARLY twenty years have passed since a new type of synthetic rubber was announced at a meeting of the American Chemical Society in Akron. First introduced commercially under the trade name "DuPrene," this chemical rubber was later named neoprene. Neoprene is a generic name. It describes a family of chemical rubbers consisting predominantly of polymerized chloroprene. By common usage it has also come to describe products in which the major elastomeric constituent is polymerized chloroprene.

The neoprenes are made in two forms; so-called "dry" polymers which bear a close resemblance to crude rubber, and water dispersions, known as neoprene latices, which are indistinguishable from natural-rubber latex on casual examination. The several types of neoprene and neoprene latex all possess to a high degree the outstanding properties for which neoprene is noted. These include resistance to deterioration by oils, solvents, and chemicals, sunlight and weathering, oxidation, heat, flexing, abrasion, and flame. However, each type has its own special characteristics which contribute to its usefulness in specific applications.

The various types of neoprene may be divided conveniently into two classes: the all-purpose types which are used in most applications in which the general characteristics of neoprene vulcanizates are desired; and the special-purpose types which have been developed specifically to provide outstanding performance with respect to certain physical characteristics, such as low-temperature flexibility.

In making a neoprene product, the rubber-goods manufacturer not only has his choice of any one of a number of neoprene polymers but also is able further to modify the properties of the finished product by the choice of fillers, softeners, and vulcanizing agents, which he incorporates into the neoprene. There are literally thousands of different neoprene compounds available, each of which has its own particular characteristics. In the final analysis the correct neoprene compound for a specific job depends on the skill and knowledge of the manufacturer.

The fact that there are so many different neoprene compositions commercially available makes it difficult for the engineer to know just what combination of properties is basic and specific to neoprene. It is the purpose of this paper to discuss some of the principal properties of neoprene compositions and to describe some of their engineering applications.

In the discussion which follows, the values reported are typical of those obtainable in commercial practice. Unless otherwise specified, the characteristics described were obtained with the general-purpose types of neoprene. It should be remembered, of course, that optimum performance with respect to all properties cannot be obtained in a single compound. In practice it is usually necessary to effect a compromise between the conflicting requirements of an application. For example, a neoprene composition cannot have the utmost in tear resistance and at the same time be extremely soft. In designing a compound, one of the two must predominate or, as is more often the case, a compromise is necessary. Some softness is sacrificed in the interest of improved tear resistance.

In discussing the properties of a neoprene composition, it is convenient to divide the discussion into two phases as follows:

Basic Properties. These include all the characteristics such as hardness, tensile strength, compression set, and resilience which govern its ability to perform its function upon being placed in service.

Resistance to Deterioration. This covers measurements of the extent to which original properties are retained during exposure to deteriorating influences such as oil, sunlight and weathering, oxidation, and heat.

BASIC PROPERTIES OF NEOPRENE

The range of basic properties obtainable with neoprene compositions is not much different from what can be obtained with other elastomers. For example, neoprene compounds can be obtained having durometer hardnesses ranging from less than 30 to more than 90. Typical commercial neoprene compositions have tensile strengths ranging from about 800 psi to about 4000 psi, depending on the way in which they are compounded. The tear resistance of neoprene compounds is of the same order as that of similar compounds of other elastomers. However, some of the basic characteristics of neoprene compositions warrant discussion either because they are little understood or because they are significantly different from those of compounds of other elastomers.

Compression Set. Compression set is a measure of the elastic-recovery properties of a composition after conditioning under load for a prescribed time at a definite temperature. The lower the compression set, the better are the elastic-recovery properties. It is a useful measurement for gasketing and sealing materials since it indicates the extent to which a composition can be expected to maintain an adequate sealing pressure in service. It is also useful in other applications where a composition is expected to function under load with minimum permanent distortion. Recent research has resulted in the development of a new general-purpose neoprene polymer which has outstandingly low compression set. The performance of this type of neoprene is vastly superior to that of the early types, especially at high service temperatures.

The data in Table 1 compare the compression-set values obtained with this type of neoprene with those of a natural-rubber composition designed to have minimum compression set. Note that the neoprene compound is superior to the rubber composition at all conditioning temperatures.

Dynamic Properties. The dynamic characteristics of elastomers are of importance in such products as vibration isolators, tires, V-belts, and flexible couplings. Among the chemical rubbers, neoprene is generally acknowledged to have dynamic

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TABLE 1 COMPRESSION-SET NEOPRENE VERSUS RUBBER

(Specimens conditioned at 30 per cent deflection for 70 hr)

	Per cent compression set at		
	158 F	212 F	250 F
Neoprene	13	18	20
Rubber	20	28	38

characteristics most closely approaching those of natural rubber. What is not well understood, however, is that neoprene compositions are actually superior to those of rubber in the practical hardness range.

The curves in Fig. 1 compare the resilience of similar neoprene and natural-rubber compositions over a range of hardness. Note that the resilience of the natural-rubber compounds is superior to that of the neoprene compositions only in the low hardness range. As hardness is increased by the addition of fillers, the resilience of the rubber stocks decreases at a faster rate than that of the neoprene stocks. The point at which

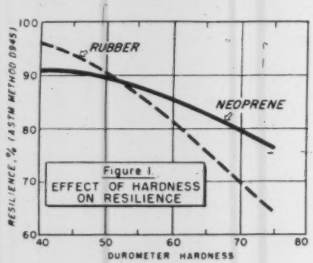

FIG. 1

the two curves cross depends largely on the type of filler used to adjust hardness. With the particular filler used in this study, neoprene compositions having a hardness above 50 to 55 showed greater resilience than similar rubber compositions. This, of course, is the practical range of hardness for products such as vibration isolators.

The energy loss in a cycle of deformation (i.e., the hysteresis) is dissipated in the form of heat. Since elastomers are not sufficiently good heat conductors to dissipate the heat as rapidly as it is generated, rapid vibration may result in a substantial temperature rise within a compound. Knowledge of the heat build-up characteristics of a composition is important because (1) the physical strength of all rubberlike materials decreases with increasing temperature, and (2) the rate of deterioration of a composition due to "aging" (oxidation) increases rapidly with increasing temperature.

The rubber technologist measures temperature rise by subjecting standard specimens to vibration of definite frequency and stress, or frequency and amplitude. The forced-vibration machines for conducting such tests are known as flexometers. The curves in Fig. 2 show the temperature rise of similar compounds of neoprene and rubber over a range of hardness. Tests were run on a Goodrich flexometer in which the specimen was vibrated at a constant amplitude of $^{3}/_{16}$ in. and a frequency of 1800 cycles per min (cpm) under a static load of 150 psi. Temperature rise was measured after 20 min flexing, by which time temperature equilibrium had been established.

As would be expected from their higher resilience, neoprene compositions in the higher range of hardness show lower heat build-up (i.e., lower hysteresis) than similar rubber compounds.

Creep and Stress Relaxation. Creep, the increasing deflection of a material under constant stress, is exhibited in varying degrees by all solids. The converse of creep is stress relaxation, the decrease of stress in a material subjected to constant strain. It has been a common idea that neoprene compositions show greater creep or stress relaxation than do similar rubber stocks. However, this conclusion usually has been based on short-time tests.

Data comparing the long-term-creep-characteristics of similar rubber and neoprene stocks are shown in Fig. 3. Note that the initial creep of the neoprene compounds, as indicated by the one-day values on the curves, is substantially higher than that of the natural-rubber compositions. However, the slope of the creep curve is considerably higher in the case of the rubber compositions so that the actual values for the neoprene and rubber specimens approach each other after prolonged conditioning.

Many improvements have been made in the inherent properties of neoprene polymers and in compounding techniques since the data shown in Fig. 3 were obtained. Preliminary results of creep tests on recently developed neoprene compounds indicate that their performance is significantly better than that of the neoprene compound shown in Fig. 3, especially with respect to initial creep.

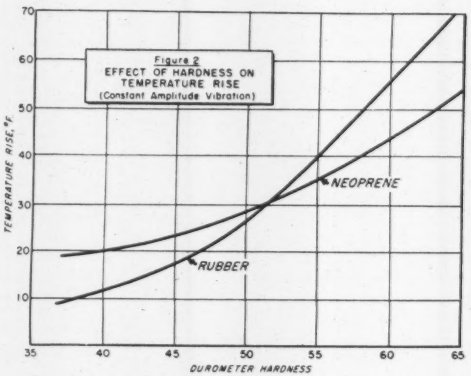

FIG. 2

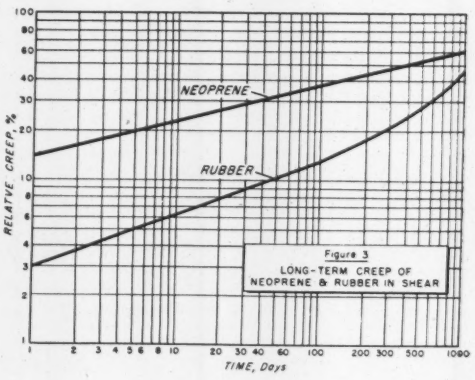

FIG. 3

Low-Temperature Behavior. The changes which take place in elastomers at low temperatures are of two types; (1) those which take place rapidly—as soon as temperature equilibrium is established, and (2) those which occur only after prolonged exposure to low temperatures.

The first type includes (*a*) simple temperature effects which are gradual changes in such properties as hardness and resilience, and (*b*) second-order transitions which result in a sharp increase in stiffness within a relatively narrow temperature range which is characteristic of a given composition. The stiffness caused by second-order transitions may result in brittleness under conditions of impact loading. The highest temperature at which brittleness is noted under definite conditions of loading is commonly known as the brittle point.

In general, simple temperature effects and second-order transitions affect neoprene compositions in the same way as they do compounds of other elastomers. This is illustrated by the curves in Fig. 4 which show hardness as a function of temperature for compounds of (1) a general-purpose neoprene polymer, (2) a special freeze-resistant neoprene polymer, and (3) natural rubber. No attempt was made to compound any of the elastomers for outstanding low-temperature flexibility.

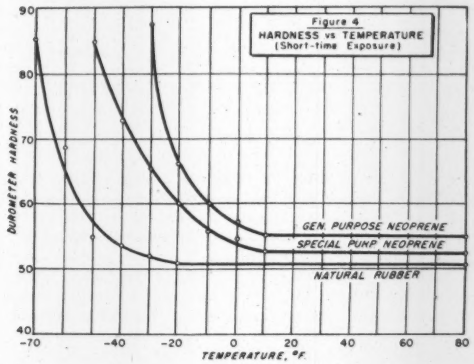

FIG. 4

Note that the use of a special-purpose neoprene polymer offers a substantial advantage over the general-purpose type. For example, on cooling from room temperature to —30 F, the general-purpose neoprene increased in hardness by about 30 durometer points. The hardness of the freeze-resistant neoprene, on the other hand, increased only 14 points.

Special compounding techniques can be used to improve the low-temperature flexibility of neoprene compositions. The extent of the improvement which can be obtained by proper compounding is illustrated by the data in Table 2. The data show the brittle points of similar compounds of a general-purpose neoprene polymer and a freeze-resistant neoprene polymer (*a*) containing no softener, and (*b*) containing a low-temperature plasticizer. Brittle temperatures were determined in accordance with ASTM D 746.

TABLE 2 EFFECT OF COMPOUNDING ON BRITTLE TEMPERATURE

	—Brittle temp, deg F (ASTM D 746)—	
Polymer type	No softener	With low-temp plasticizer
General purpose	—40	—65
Freeze-resistant	—50	—95

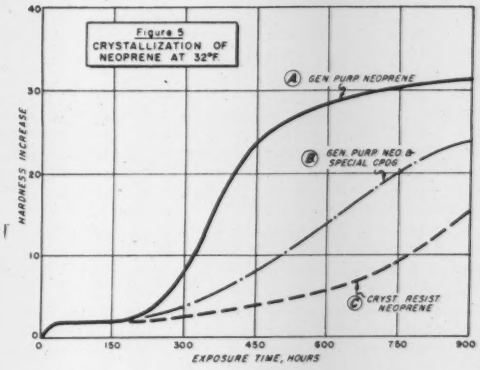

FIG. 5

In the case of both types of polymer, the improvement obtained by compounding is substantial. The brittle temperature of the general-purpose neoprene was lowered by 25 F, while that of the freeze-resistant polymer was depressed 45 F.

Prolonged exposure at low temperatures may result in changes other than those just described. The most important of these time effects is crystallization. Crystallization takes place only at moderately low temperatures (e. g., —30 to +50 F), and is evident as a delayed stiffening. It may take hours, days, or even weeks for stiffening to occur. The rate at which it occurs depends both on the type of composition and the conditions of exposure. Crystallization, like other low-temperature changes, is reversible. Heating of the composition or subjecting it to mechanical working will break the crystal-like structure and restore the composition to its original condition.

Among the major elastomers only natural rubber, butyl rubber, and most types of neoprene are crystallizable. In the case of all of them, the rate of crystallization is increased by placing the vulcanizate under strain. For each of them there is a temperature at which crystallization takes place most rapidly. In the case of the crystallizable types of neoprene, this temperature is 32 F, while for rubber it is reported to be about —15 F. Above and below the optimum temperature, crystallization takes place less rapidly; in fact, at room temperature or at extremely low temperatures, such as —50 F, crystallization does not occur for practical purposes.

Despite its reversibility, crystallization results in temporary changes in physical characteristics and in stress-relaxation tendencies which are frequently objectionable. Fortunately, crystallization can be minimized or eliminated, (1) by using the proper neoprene polymer, and (2) by proper compounding and curing.

The curves in Fig. 5 show the effects of both methods of approach on crystallization as judged by hardness change during prolonged exposure at 32 F. Curve A shows the crystallization tendencies of the most commonly used general-purpose neoprene polymer. Note that there is a gradual increase in hardness followed by a fairly rapid increase after about 200 hr of exposure. Curve B shows the effect of special compounding on crystallization of the same neoprene polymer. A comparison of curves A and B shows that both the rate and extent of crystallization have been decreased by proper com-

pounding. The compound used to obtain curve C was based on a type of neoprene which is modified during manufacture so as to have reduced tendency to crystallize. The improvement is obvious.

If a similar test were conducted using the special freeze-resistant neoprene polymer mentioned in connection with Fig. 4 and Table 2, no increase in hardness would be noted since the freeze-resistant type of neoprene is not crystallizable.

Other Basic Properties. A brief review of some of the other basic properties of neoprene compounds will serve to complete this phase of the discussion.

The dielectric properties of neoprene are somewhat inferior to those of rubber and GR-S. However, neoprene compositions are adequate as insulators at low voltages. Volume resistivities of the order of 10^{12} ohm-centimeters can be obtained with insulation-type compositions. Conductive compositions also can be made having resistivities as low as 10^{2} ohm-centimeters. The dielectric strengths of typical commercial neoprene stocks range from 150 to 550 volts per mil.

Neoprene polymers are inherently flame-resistant. While they can be made to burn, they will not support combustion, provided they are not compounded with excessive quantities of flammable materials such as hydrocarbon softeners.

Neoprene compositions have excellent resistance to diffusion of gases. The permeability of neoprene to gases is from one fourth to one tenth that of rubber, depending on the particular gas.

RESISTANCE TO DETERIORATION

The original characteristics of a composition are obviously important. However, the ability to retain these properties under a wide variety of service conditions is frequently more important. The widespread use of neoprene compositions is due largely to their ability to resist deterioration due to oils, solvents, and chemicals; to sunlight and weathering; to aging (oxidation); to ozone; and to heat.

Oils and Solvents. The extent to which a neoprene product is affected by contact with oils, solvents, and chemicals depends on many factors, the most important of which are the following:

1 The chemical nature of the immersion medium.
2 The service temperature.
3 The ratio of exposed area to total volume of the part.
4 The type of service (i.e., continuous or intermittent, static or dynamic, etc.).

It is well known to practically all engineers that two immersion media of vastly different chemical composition, such as carbon tetrachloride and a lubricating oil, are likely to exert quite different effects on elastomers. What is not well known, however, is that less obvious differences in chemical composition may also be important. For example, lubricating oils of the same SAE viscosity grade but obtained from different crudes may have significantly different effects. This is illustrated by the data in Table 3 which show the equilibrium volume increase of a neoprene composition after immersion at 212 F in SAE 20 lubricating oils from different crude stocks.

The data show that substantial differences are obtained not only with oils of different chemical type, but even with different oils from crudes of the same general class.

TABLE 3 SWELLING EFFECT OF SAE 20 LUBRICATING OILS AT 212 F

Source of crude	Chemical type	Volume increase, per cent
Pennsylvania	Paraffinic	13
Pennsylvania	Paraffinic	29
Mid-continent	Naphthenic	62

The effect of temperature is another factor of importance in determining the suitability of neoprene for a given service. This is illustrated in Fig. 6 which shows the equilibrium swell of a neoprene composition in each of three oils over the temperature range 75 to 300 F. The immersion media were chosen to simulate the effects of a wide range of petroleum derivatives. ASTM No. 1 oil simulates the action of lubricating oils derived from Pennsylvania crudes. The effect of ASTM No. 2 oil is similar to that of naphthenic-base lubricating oils from Coastal or Gulf crudes. ASTM No. 3 oil has an effect similar to that of fuel oils or of naphthenic-base crude.

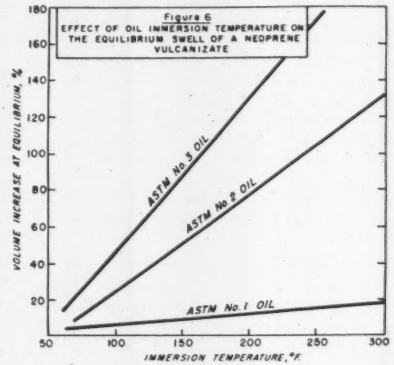

FIG. 6

As would be expected, volume increase is proportional to temperature for any given immersion medium. What is interesting to note, however, is that slopes of the curves are quite different. Hence a comparison of the effects of two oils at one temperature does not permit accurate prediction of their relative effects at some other temperature.

Standard laboratory immersion tests are conducted using test specimens 1 in. × 2 in. × 0.075 in. This type of sample has a much higher ratio of exposed area to total volume than is encountered with most finished products. An interesting illustration of the importance of the area/volume ratio is shown by the data in Table 4. Tests were conducted using typical hose-tube compounds in the form of cylinders 10 in. long × 1/2 in. ID × 3/4 in. OD. One tube was immersed completely for 48 hr at room temperature in aviation gasoline containing 40 per cent aromatics. A second tube was merely filled with the same aviation fuel for the same period.

TABLE 4 EFFECT OF AREA/VOLUME RATIO ON DIMENSIONAL CHANGE IN AVIATION GASOLINE

	10-in. × 1/2-in. × 3/4-in. tube	
	Immersed	Filled
Ratio of exposed area to total volume, sq in./cu in.	16.2	6.4
Change in length, per cent	12.1	1.3
Change in wall thickness, per cent	15.9	3.5

As the data show, the area/volume ratio for the immersed tube is only 2 1/2 times greater than that of the filled tube; yet the percentage increase in length is nearly 10 times greater, and the change in wall thickness more than 4 times as great.

Since the area/volume ratio of the standard immersion specimen is even greater than that of the immersed tube, the conventional immersion test would exaggerate the effect even more. Obviously, then, any maximum limit on volume increase, as determined by standard laboratory immersion tests, must be selected with due regard to the product involved and the exposure conditions. For example, a gasket which has only a thin edge exposed will perform satisfactorily in contact with many chemicals which have a great enough swelling effect to cause rapid distortion and failure of a thin regulator diaphragm.

The question of continuous versus intermittent service is especially important in applications involving contact with the many highly volatile materials, such as benzene and trichloroethylene, which are widely used as chemical-process intermediates, solvents, and degreasing agents. Even though "continuous" contact with trichloroethylene, for example, may result in substantial deterioration of a neoprene composition, the same composition may be satisfactory for "intermittent" contact with this solvent. This is understandable since intermittent contact allows time for evaporation of highly volatile chemicals, so that the compound rapidly regains its original properties. The speed with which physical strength is regained is illustrated in Fig. 7 which shows the effect of drying time on the tensile strength of a neoprene composition after immersion in trichloroethylene for 24 hr at room temperature.

Note that the tensile strength of the composition, measured immediately after removal from the solvent was only 50 per

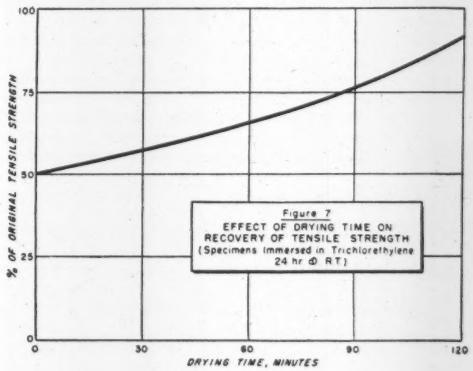

FIG. 7

cent of its original value. After only 2 hr of drying, however, the tensile strength of the composition returned to 90 per cent of its original value.

Up to this point our discussion has been confined to illustrating the effects of some of the important variables on resistance to oils and solvents. Having established that the specific service conditions must be considered before an accurate prediction can be made, it is probably safe to make a few broad generalizations:

1 Neoprene compounds usually render excellent service in contact with (*a*) all straight-chain hydrocarbons even when substantial amounts of aromatic constituents are added, as in some types of aviation gasoline, (*b*) all aliphatic hydroxy compounds such as methyl and ethyl alcohols and ethylene glycol, (*c*) animal and vegetable fats and oils, and (*d*) most "Freon" refrigerants.

2 Neoprene compounds are either unsuitable or have limited serviceability when used in contact with (*a*) chlorinated hydrocarbons, such as chloroform and benzylchloride, (*b*) organic esters such as butyl acetate and methyl salicylate, (*c*) aromatic hydrocarbons such as toluene and benzene, (*d*) aromatic hydroxy compounds such as phenol and cresol, and (*e*) some ketones, especially mixed ketones such as methyl-ethyl ketone.

Chemicals. In the case of other chemicals the same variables mentioned in connection with oils and solvents are important. In most cases, however, differences are of a smaller magnitude.

Generally speaking, neoprene compositions render excellent service even at elevated temperatures, in contact with (*a*) dilute mineral acids, except those of a strong oxidizing nature, (*b*) all alkalies including concentrated sodium and potassium hydroxides, and (*c*) all solutions of inorganic salts, except those of a strong oxidizing nature.

Neoprene is either unsuitable or has limited serviceability in contact with strong oxidizing agents such as nitric acid, potassium dichromate, concentrated sulphuric acid, and hydrogen peroxide.

In cases where the suitability of neoprene is doubtful, the use of simulated or actual service tests is recommended before adopting the use of a neoprene product.

Sunlight and Weathering. Probably as much neoprene is used in applications where resistance to sunlight and weathering is the key property as is used in applications where the major requirement is oil resistance.

The superiority of neoprene compositions over similar rubber compounds is clearly shown in Figs. 8 and 9. Fig. 8 shows the rubber cover of a garden hose after several years of continuous service. Note the extent of the cracking due to sunlight and weathering. Fig. 9 shows a neoprene-covered garden hose after the same period of use. Note that there is no evidence of deterioration.

Aging. Deterioration on aging is actually due to oxidation by the oxygen in the air. Neoprene compositions have unusual resistance to oxidation as has been established both by laboratory tests and by actual service. The most common test for determining the age resistance of elastomers involves subjecting a vulcanized specimen to pure oxygen at a pressure of 300 psi and at a temperature of 158 F. This is commonly known as the oxygen-bomb test. Since the rate of oxidation is increased both by increased oxygen concentration and by increased temperature, the test is a severe one.

The data in Table 5 compare the aging characteristics of similar neoprene and natural-rubber compositions as judged by the oxygen-bomb test. Specimens of each were removed at regular intervals and their tensile properties determined. The number of days of exposure required to reduce the tensile strength of the composition to 50 per cent of its original value is reported as a measure of age resistance. Note that the rubber stock lost 50 per cent of its tensile strength after only 21 days in the bomb. In contrast, 41 days of exposure were required to deteriorate the neoprene composition to the same extent.

TABLE 5 EFFECT OF AGING ON NEOPRENE AND RUBBER

(Specimen aged in oxygen bomb at 158 F and 300 psi pressure)

Elastomer	Time to lose 50 per cent tensile strength, days
Neoprene	41
Rubber	21

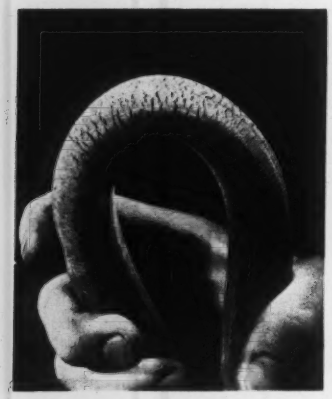

FIG. 8 RUBBER-COVERED GARDEN HOSE AFTER SEVERAL YEARS OF CONTINUOUS OUTDOOR USE
(For comparison with neoprene, see Fig. 9.)

FIG. 9 NEOPRENE-COVERED GARDEN HOSE AFTER SEVERAL YEARS OF CONTINUOUS OUTDOOR USE
(For comparison with rubber, see Fig. 8.)

Ozone. Ozone, which is oxygen in an extremely active form, attacks most elastomers very rapidly and causes severe deterioration. Since high concentrations of ozone are found in the vicinity of electrical equipment and at high altitudes, ozone resistance is an important requirement for many applications. Even under ordinary service conditions, enough ozone is present in the atmosphere to affect the useful life of compounds of many elastomers. Fig. 10 shows the condition of similar neoprene and natural-rubber compositions after exposure to ozone. Note that the same relationship holds between the two as was shown in the case of weathering (Figs. 8 and 9). This is to be expected since ozone attack is generally considered to be an important factor in deterioration due to weathering.

Heat. Neoprene compositions have excellent heat resistance. Unlike natural rubber, which fails by becoming soft and sticky, neoprene becomes harder on exposure to heat and eventually fails by becoming brittle.

In most applications, neoprene compositions can be used for continuous service at temperatures up to about 250 F. In intermittent service, neoprene compositions have rendered satisfactory service at temperatures of 300 F and over. In cases where service temperatures exceed 180 to 200 F, the use of specially compounded heat-resistant compositions is recommended.

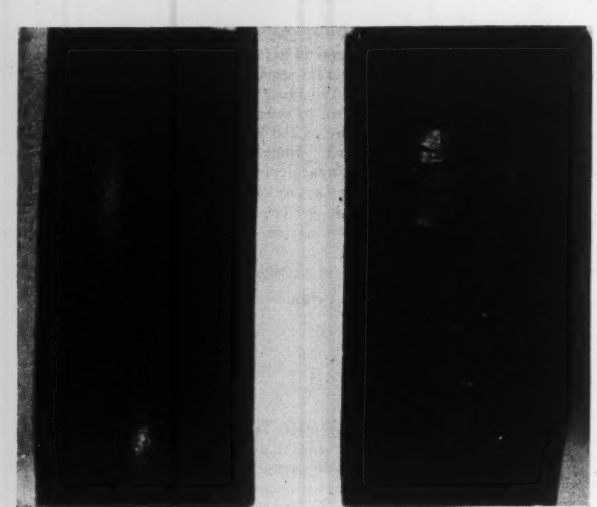

FIG. 10 NEOPRENE AND RUBBER WIRE COMPOUNDS AFTER EXPOSURE TO OZONE
(The neoprene is shown at the left.)

APPLICATIONS

Since neoprene is used in literally thousands of different products, only some of the major uses and some of the more unique applications will be considered.

One of the major fields of application for neoprene is in hose. For example, air hose with a neoprene lining is used where hot oil is injected into the air stream for tool lubrication. In gasoline-pump hose, neoprene is used not only as a gasoline-resisting inner liner, but also as a cover, since its resistance to sunlight and weathering assures complete protection to the reinforcing braids over a long period of time. Neoprene-lined hose is used to convey propane and butane since it has low permeability and a high resistance to deterioration by these materials. Neoprene has long been used in the manufacture of flat transmission and V-belts, as well as conveyer belts where service conditions require resistance to oil, flexing, and high temperatures.

In electric power transmission, neoprene is used as a protective covering for many types of wire and cable. For instance, a protective neoprene sheath is now used as a replace-

(*Continued on page 643*)

MULTIFUEL BURNERS

Their Application and Design

By W. H. DECKER

SINCLAIR REFINING COMPANY, EAST CHICAGO, IND. JUNIOR ASME

THERE has been a limited amount of published data on the application of multifuel burners, or as often termed "trifuel burners," to industrial steam-generating equipment. The reason for this, perhaps, lies in the fact that such burners have had limited acceptance when compared with the widespread use of combination oil-gas, oil-coal, gas-coal, or single-fuel burners. This paper reviews the desirability and certain of the possible economics of the application of these burners for the average industrial user, and considers some of the designs currently obtainable.

FUEL-BURNING-EQUIPMENT DESIGN

The engineer when designing a new fuel-burning installation is confronted with the problem of the selection of the fuel or fuels to be used. Essentially the choice of the fuel or fuels will dictate the type, arrangement, required attendant auxiliaries, first cost, and erection charges of the equipment. While there are many factors peculiar to any one installation, which must be evaluated in fuel selection, there are two principal ones of importance—fuel cost and fuel availability. The designer must choose that fuel which is the most readily obtainable at the least cost. For any one installation the fuel meeting these specifications may be coal, fuel oil, fuel gas, certain by-product fuels, or waste fuels. In many cases an alternative fuel is chosen for specific stand-by purposes and the final design is then based upon these one or two fuels.

The design and installation of equipment on this premise is fundamentally shortsighted as it does not make allowance for future contingencies resulting from conditions beyond the control of the designer. Basically sound design must be made on the assumption of the most economical continuous operation throughout the life of the installation. Unfortunately, neither the designer nor the prospective purchaser is in a position to predict the fuels situation during the service period of the proposed unit. Therefore due regard must be made for this inability to foresee the future fuel-market conditions. The fuel producers are not in a position to guarantee a continuing unfailing supply of a given fuel inasmuch as it is largely controlled by basic resources, strikes, national emergencies, and the like.

An example of this condition is that of the recent nationwide coal strikes. Faced with the problem of immediate unavailability of their primary fuel, certain plants were forced to the use of an alternative fuel. A number of these forced conversions were inadequate, costly, and difficult to operate. Nevertheless conversions had to be made so as to maintain uninterrupted operation of the manufacturing processes served by the fuel-burning equipment. This would also be true in the event of a national emergency or a war during which time fuel oils become scarce.

The same conditions apply with equivalent effect to the cost structure of fuels. The originally elected fuel is usually the lowest cost one obtainable; however, this particular one may well become the most expensive due to the changing economy of the country. An illustration of this fact can be seen from the average cost at refinery terminals of heavy fuel oils in the Chicago area over the past six years.

TABLE 1 HEAVY FUEL-OIL COSTS IN CHICAGO AREA

Year	Cost per bbl
1945	$1.60
1946	1.87
1947	2.34
1948	3.00
1949	2.28
1950	2.54

This is a good example of a fuel price change, as there has been a maximum differential of $1.40 per bbl over the period under consideration. Similarly, other fuels are equally subject to price variations. An installation designed around the consumption of $1.60 per bbl fuel oil, which may be required to operate several years later with fuel costs 85 per cent greater, will undoubtedly be operating under unfavorable economic conditions. With fuel costs averaging 85 to 90 per cent of the total costs of steam or energy produced, it is readily evident that operating costs will increase in proportion to fuel prices.

In the last analysis neither fuel price nor fuel availability can be considered alone since each is materially affected by the other. Thus the designer is faced with the necessity of insuring both minimum costs and continuity of operations at all times. The only means by which this can be done is by installing equipment which will adequately handle coal, fuel oil, fuel gas, or in some cases by-product or waste fuels—coke, petroleum pitch, refinery or natural dump gases, coke-oven gas, producer gas, asphalt, tar, acid sludge, and many others. It is apparent, however, that these considerations do not apply in all cases. An example of this would be the Gulf Coast area where natural gas is both cheap and abundant, with other fuels usually not competitive. If by-product fuels are not available, complete fuel flexibility may not be justifiable in such areas.

If the designer can incorporate into the original installation all of the necessary equipment to handle solid, liquid, or gas fuels, then the most economical over-all operation will be assured. The selection of the fuel to be burned is then not controlled by the equipment, but by current market considerations. Under these conditions the minimum operating costs are assured at all times, at least from the standpoint of expenditures for fuel. In addition, the manufacturing units served by such fuel-burning equipment are practically independent from the effect of strikes, shortages caused by a state of national emergency, or war. It is realized that provision for the burning of all types of fuels does not represent the least costly original installation; however, this is many times offset by subsequent changes in the cost and availability structure of the fuels to be used. A period of curtailed production, forced shutdown, or operation at premium fuel prices due to a short

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supply of a single fuel may more than compensate for the higher initial first cost of a multifuel installation.

ILLUSTRATIVE EXAMPLE

An illustration of the economics involved for a situation of this type is as follows: In a typical manufacturing concern in the Midwest, with which the writer is familiar, these conditions have prevailed. The central steam plant, which generates process steam and by-product power, is equipped to burn pulverized coal, heavy fuel oil, or fuel gas. This unit under full-capacity operations consumes the equivalent of 1000 tons of coal per day. Based upon equipment design and manpower requirements for handling and preparation, it costs a maximum of 75 cents per ton to burn coal. This cost includes an adequate charge for maintenance and repair work. For this plant the fuel-oil equivalent per ton of coal is equal to 3.24 on a Btu basis, or 3.24 bbl of oil are required to replace a ton of coal. Coal screenings cost approximately $5.25 per ton delivered to the plant. From these data Table 2 was calculated.

TABLE 2 COMPARATIVE COSTS OF COAL VERSUS HEAVY FUEL OIL

Fuel-oil cost $/bbl	Coal cost $/ton	Operating cost differential per ton coal vs. oil $/ton	Profit per day coal vs. oil $/day
$1.00	$6.00	—$2.76	—$2760
1.50	6.00	— 1.15	— 1150
2.00	6.00	+ 0.48	+ 480
2.50	6.00	+ 2.10	+ 2100
3.00	6.00	+ 3.70	+ 3700

It is evident that there is a wide range of profits realizable from coal burning as against oil burning under certain price conditions. When fuel prices change from $1.50 per bbl to $2.50 per bbl a loss of $1150 per day becomes a profit of $2100 per day. Had this plant been designed on a basis of fuel-oil burning only at $1.50 per bbl and been required to burn fuel oil costing $3 per bbl, the fuel expenditure would be about $3700 per day more than if coal screenings could be used. On a yearly basis this represents approximately $1,350,000 which would more than pay for the original installation of pulverized-coal equipment.

FUEL SELECTION

In addition to the use of the cheapest fuel from a purchased cost standpoint, the consumer must take into consideration the handling and preparation costs of any one fuel so as to determine the least costly fuel on an "as-fired" basis. The cheapest fuel from a delivered standpoint may in reality be the more expensive on an as-fired basis if preparation costs are excessive. Pulverized coal is an example of this due to the fact that the additional labor, power, mill maintenance, and ash-removal costs are well above those for either liquid or gaseous fuels. It is necessary to make a thorough study of all costs, incident to any one fuel, to ascertain the optimum balance of fuels to be used for minimum operating costs. The industrial consumer in a position to take advantage of every change in the current fuel market is capable of continuous low-cost operation.

WASTE-FUEL UTILIZATION

The preceding discussion has been based around the consideration of the more common fuels—pulverized coal, fuel oil, and fuel gas. However, it applies with equal emphasis to a number of waste or by-product fuels which are often produced from manufacturing processes. Among such fuels would be found petroleum pitch, petroleum coke, asphalt, tar, acid sludge, coke-oven gas, refinery or natural dump gases. The utilization of these waste fuels can be quite desirable provided that handling or preparation costs are not too great. It is in this connection that multifuel-burning installations may have extensive application.

In the utilization of waste fuels perhaps the greatest difficulty encountered is that the supply is often subject to wide variation over relatively short time periods. The successful burning of these fuels therefore evolves around the ability of the installed units to compensate automatically for changing fuel quantities without upsetting either steam or power production, or both, with a mimimum of operating attention. The equipment required for this automatic operation is of particular importance and accordingly should be reviewed.

MULTIFUEL COMBUSTION CONTROL

Modern instrumentation has advanced to the point where "availability-type" combustion controls are standard equipment. This availability control is one wherein fuels are proportioned to the burners in relation to their supply. These systems operate to hold an approximate fixed fuel-air ratio with additional adjustment in the total air supply to maintain sufficient fuel burning for constant steam pressure. Secondary adjustments are used to compensate for wide variation in fuel qualities, although for efficiently designed equipment the air supply is substantially the same per million Btu of heat liberation for different fuels. These controls can be so operated that any one fuel is fired in a fixed quality, with the second fuel supplied to make up the balance of the load requirement as governed by the availability of a third fuel.

A typical example of such a system is the operation of a multifuel-fired furnace designed to burn pulverized coal, heavy fuel oil with dump fuel gas to be used whenever it is in excess of normal demands. In this case the pressure in the gas main is used as a measure of the availability of the fuel gas. Fuel oil is supplied to the burners in a fixed amount with the pulverized coal used to make up any deficiency in fuel requirement not available from surplus gas burning. If no surplus of gas were available then the entire load would be carried by fuel oil and coal. Now, however, as gas becomes in excess, as evidenced by an increase in gas line pressure, the coal rate is reduced in proportion to the heat-content increase resulting from the combustion of the fuel gas. This automatic shift in fuels distribution is continued until such time as the gas line pressure is restored to normal. During this period the air flow is automatically adjusted in relation to fuel rate to maintain a constant steam pressure at varying loads. These changes in fuel supplies may occur rapidly and the operator may be unaware of the exact quantities of the various fuels being fired at any one time. Similarly the pulverized coal could be fired at a fixed quantity with the fuel oil taking up the swing in Btu requirement occasioned by varying fuel-gas supply. With such controls in service and with properly designed attendant equipment the problem of efficient utilization of variable by-product fuels is considerably simplified.

MULTIFUEL BURNER DESIGN

It is not the intention of this discussion to review all of the design features of a multifuel burner; however, there are several factors to be considered. A correctly designed multifuel burner must be capable of efficiently burning any one fuel or any combination of fuels—solid, liquid, or gases at varying burner capacities. In general, the combustion of a solid fuel is the more difficult and a burner designed with sufficient turbulence and mixing for this fuel will usually be satisfactory for liquid or gaseous fuels. Such burners should be designed to furnish enough primary air to maintain both stable and

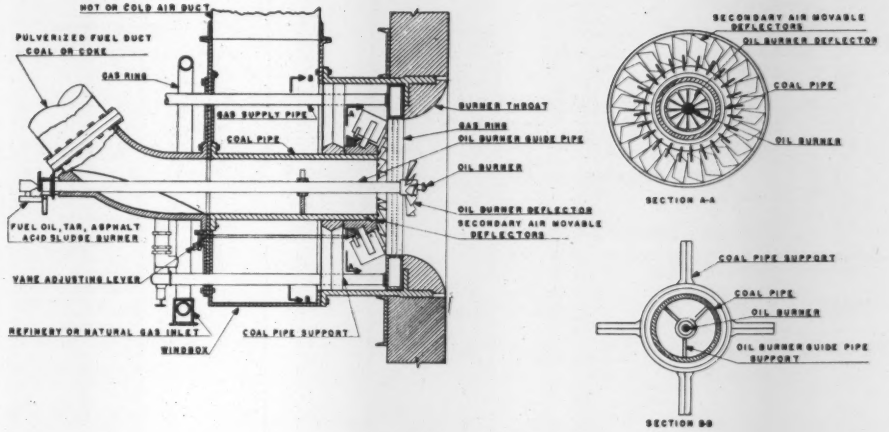

FIG. 1 BAILEY-TENNY MULTIFUEL BURNER

(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

rapid ignition, with the secondary air added under conditions of good mixing and turbulence beyond the zone of ignition. There are many ways in which these requirements can be met by differences in construction and location of burners in a given furnace.

A number of drawings simplified for illustrative purposes have been included to demonstrate the more general types and to indicate the variations in design which are permissible. Space does not permit a review of all of the many types.

BAILEY-TENNY MULTIFUEL BURNER

The multifuel burner shown in Fig. 1 is a type commonly used for the smaller industrial stations largely because of its simplicity. The primary air carrying the pulverized fuel is supplied to the combustion zone through a single coal nozzle. A stationary deflector mounted on the movable oil-burner guide pipe, installed in the center of the coal nozzle, produces partial turbulence of the air-fuel mixture. The secondary air passing around the outside of the coal nozzle is given a spinning action by means of adjustable vanes. This highly turbulent secondary-air stream results in good mixing of the air and fuel in the combustion zone and operation with low excess air is possible. The flame shape can be controlled to a large extent by positioning the secondary-air vanes and the deflector mounted on the oil-burner guide pipe. As these vanes are closed down the flame envelope is shortened and broadened out, while with more opening the flame envelope is lengthened out and narrowed. This general type of burner is capable of highly efficient operation over a wide capacity range and it has many features of easy maintenance and repair. Fuel oil is supplied through a single burner which may be of the mechanical or steam-atomizing type. Fuel gas is burned by means of a single circular ring installed inside of the burner refractory throat.

MODIFIED BAILEY-TENNY MULTIFUEL BURNER

The burner shown in Fig. 2 is the same design as that shown in Fig. 1 except for a modification required for combustion of solid low-melting-point petroleum pitch. This modification consists of a water-cooled sleeve installed inside of the coal nozzle where it is exposed to hot air in the wind box. The purpose of the sleeve is to maintain the incoming pulverized pitch - primary air mixture at a temperature below 150 F. This was done after it was found that the pitch tended to melt and adhere to the hot coal nozzle walls. This relatively simple change enabled this burner to handle pulverized petroleum pitch in addition to pulverized coal, refinery or natural gas, heavy fuel oil, tar, asphalt, or acid sludge.

BABCOCK & WILCOX MULTIFUEL BURNER

The burner shown in Fig. 3 is essentially a modification of the earlier type of Bailey-Tenny burner. It combines the same excellent features of the older design with added improvements for easy replacement and simplified maintenance. As in the earlier type the secondary-air vanes are adjustable so that both flame shape and degree of turbulence can be varied in relation to fuel rate and type of fuel. While it is the more common practice to adjust the secondary-air vanes manually, some special installations have been made with the secondary-air vanes under automatic control. For these and comparable types of burners the gas ring is installed in segments (not shown) each with a separate supply connection so that any one section may be isolated as desired. Fuel oil is fired by means of a single centrally mounted burner.

COMBUSTION ENGINEERING TYPE-R MULTIFUEL BURNER

The burner shown in Fig. 4 is a type designed to obtain uniform mixing and distribution in the coal pipe and nozzle. This is accomplished by means of integrally cast spiral ribs or rifling on the inside of the coal nozzle. This produces a spinning motion of the primary air and pulverized fuel, assuring uniform mixing. An adjustable deflector is installed in the pulverized fuel inlet connection so as to insure equal fuel distribution at the nozzle inlet. The secondary air enters the combustion zone after passing through adjustable vanes designed to produce a rotary motion. The direction of movement of this secondary air is at a different angle from that of the primary air - fuel mix which materially improves both the turbulence and the degree of mixing. This permits good combustion at high rates of heat release with low carbon losses in the ash.

The fuel gas is burned by means of a single center-fire-type of gas burner located inside the coal nozzle. This type is used frequently where the fuel gases contain appreciable foreign

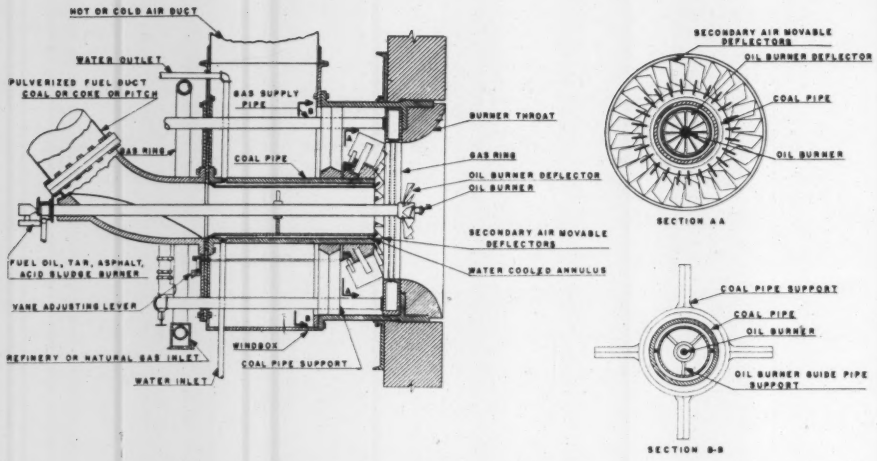

FIG. 2 MODIFIED BAILEY-TENNY MULTIFUEL BURNER FOR PITCH BURNING
(Arranged for firing pulverized coal, coke, or pitch, refinery or natural gas, fuel oil, tar, asphalt or acid sludge; singly or in combination.)

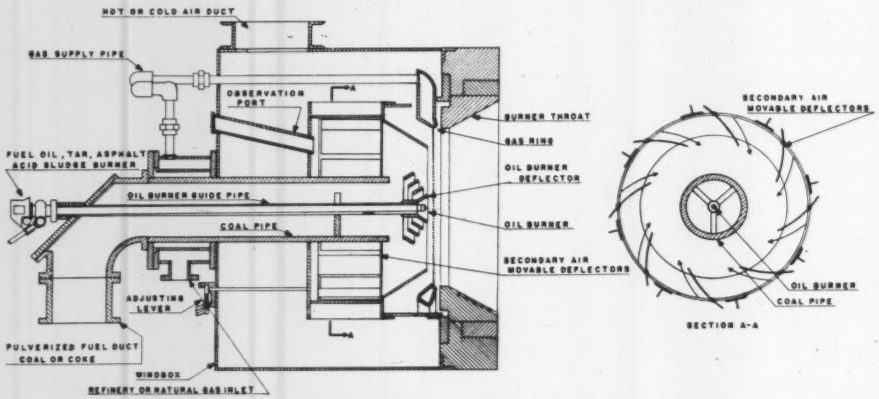

FIG. 3 BABCOCK & WILCOX MULTIFUEL BURNER
(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

matter in suspension. Fuel oil is burned in a single burner located in the center of the gas burner. While the design may be somewhat more costly than other types, its simplicity and ease of maintenance makes it a highly desirable type of multifuel burner.

PEABODY MULTIFUEL BURNER

The multifuel burner shown in Fig. 5 is an excellent example of a type making use of a tertiary air stream to promote better mixing, turbulence, and control. The primary-air stream carrying the pulverized fuel enters the middle section of the burner through a tangential connection designed to produce a spiraling motion to the air-fuel mixture as it passes into the coal pipe and nozzle. The secondary air enters through adjustable vanes similarly designed to produce a spinning action. The resulting mixing of primary air and fuel with secondary air occurs at the center of the pulverized-fuel chamber and then passes out through the coal nozzle to the combustion zone. The tertiary-air stream enters the annular space between the wind box and the coal nozzle tangentially and then enters the burner throat with a rotating movement. This type of burner offers much in the way of flexibility in controlling the air-fuel mixing and the flame pattern. This unit is capable of high rates of heat release and wide ranges in operating capacity.

Fuel oil is fired by means of a single centrally mounted oil burner, either the steam or mechanical-atomizing type. Fuel gas is supplied by a single circular ring mounted externally around the burner throat. The single gas ring may be replaced by a center diffusion-type burner if desired.

FOSTER WHEELER INTERVANE MULTIFUEL BURNER

The multifuel burner shown in Fig. 6 is an excellent example

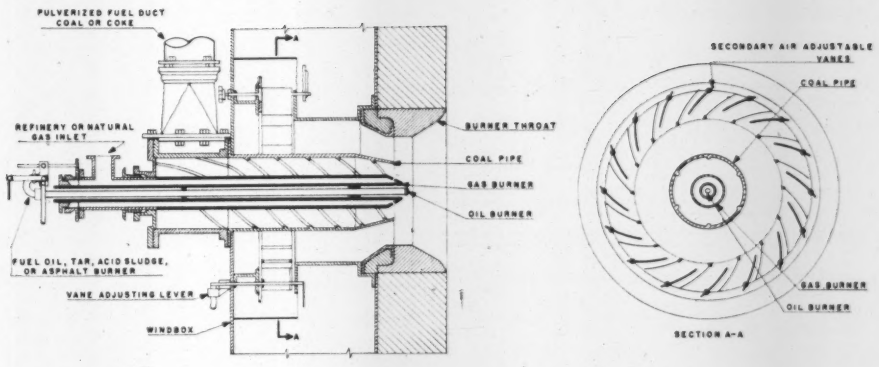

FIG. 4 COMBUSTION-ENGINEERING TYPE-R MULTIFUEL BURNER
(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

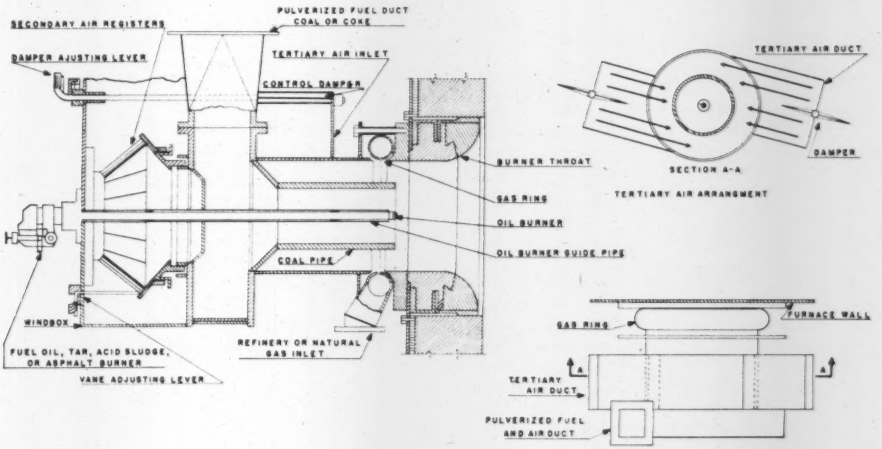

FIG. 5 PEABODY MULTIFUEL BURNER
(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

of a unit combining the maximum in fuel and air flexibility for different conditions of operation. It is the most complicated type reviewed and would correspondingly be more costly. However, for varying conditions of operation with different fuels and fuel rates, such a design is to be recommended. This particular burner is characterized by two separate pulverized-fuel burners—one primary and one auxiliary. This provides for wide rangeability in rate of pulverized-fuel firing, which in many instances is a desirable feature since it permits satisfactory low-rate operation. The primary pulverized fuel - air mix enters the burner proper through a tangential duct arrangement which produces a whirling motion of the mixture through the outside annular coal-burner nozzle. The auxiliary pulverized fuel - air mixture enters the combustion zone through an annular space around the oil-burner guide pipe. Secondary air is admitted to the combustion zone by means of adjustable vanes mounted on the end of the coal nozzle. Changes in these vanes allow for control of flame pattern and secondary-air flow. Tertiary air is supplied from the secondary-air system by means of adjustable vanes which may be varied to produce tertiary-air rotation in the same or opposite direction to the rotation of primary pulverized fuel-air mix. This tertiary air flows through the coal nozzle in the intermediate annular space between the pulverized-fuel nozzles. Fuel oil is supplied by means of a single burner mounted in the center of the coal pipe. Fuel gas is burned by means of a single gas ring mounted around the throat opening.

The combination of the two pulverized-fuel burners together with both secondary and tertiary air results in a high degree of turbulence and consequent good mixing. By means of the adjustable vanes on the secondary and tertiary air and the ability to control and change direction of rotation of the tertiary air, almost any desired degree of both mixing and flame shape may be achieved when burning varying types and combinations of fuels. These advantages are at the expense of a more costly and complicated installation requiring more

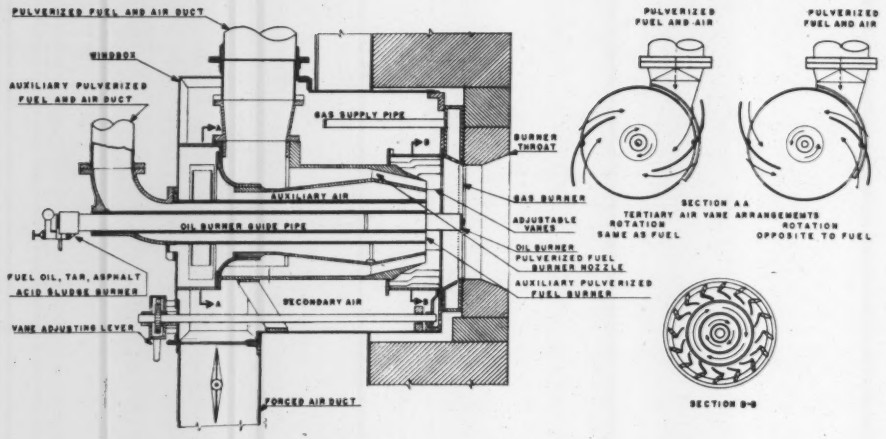

FIG. 6 FOSTER WHEELER INTERVANE-TYPE MULTIFUEL BURNER
(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

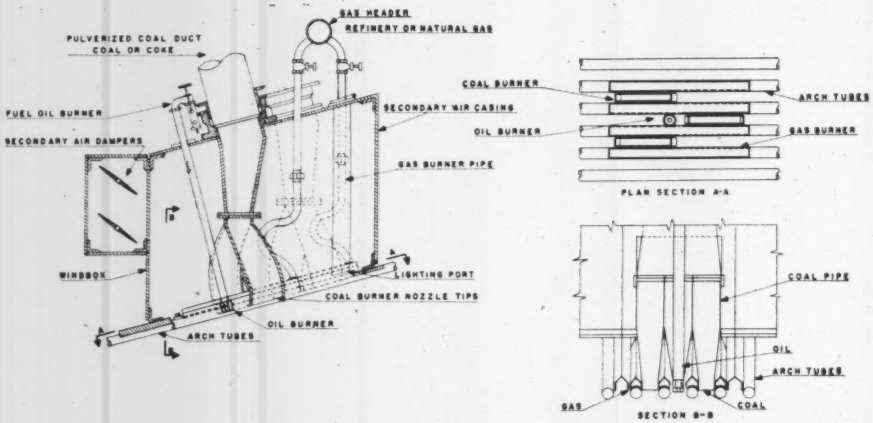

FIG. 7 FOSTER WHEELER VERTICAL INTERTUBE MULTIFUEL BURNER
(Arranged for firing pulverized coal or coke, refinery or natural gas, fuel oil, asphalt, acid sludge, or tar; singly or in combination.)

difficult maintenance. For this reason it probably would not be justified, except in certain special cases, to install such a burner on small-capacity furnaces. However, for large-scale installations this type has many recommending features.

FOSTER WHEELER INTERTUBE MULTIFUEL BURNER

The discussion thus far has been concerned with the horizontal multifuel burners designed to mount on the side walls of the furnace. There is another general type commonly used on the larger-capacity boilers. These are of the intertube burners designed for vertical firing, of which a typical example is shown in Fig. 7. In this burner the pulverized coal and fuel gas are supplied to the combustion zone by means of rectangular-shaped nozzles mounted between adjacent arch tubes. The fuel oil is burned in single burners also installed between the tubes. The burner for the same fuels is installed in a staggered pattern between the tubes so that uniform flame distribution is assured when only one fuel is being burned. Secondary air is admitted progressively around the individual burners. These and similar burners are capable of highly efficient operation with low excess air and uniform flame and temperature distribution in the furnace. They are used primarily with low-volatile fuels and are not as satisfactory for liquid or gaseous fuels as are certain of the horizontal burners. In addition they are not as adaptable to the smaller furnaces, requiring a high narrow furnace shape.

OTHER MULTIFUEL BURNERS

It is evident from this brief review of some of the principal types of multifuel burners that almost any design can be installed for a given service. There are many modifications

(*Continued on page 661*)

The ENGINEERING PROPERTIES *of* SILICONE RUBBERS

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INTRODUCTION

SILICONE rubbers, like all silicone products, are unique among comparable organic materials because of the properties inherent in their chemical structure. Silicones are partly organic and partly inorganic materials. They are built on an inorganic chain made up of alternate silicon and oxygen atoms. Various organic groups can be attached to the unoccupied valances of the silicon atoms.

The properties of silicone products are determined by the chain length, by the type and number of organic groups attached to the silicon-oxygen chain, and by the amount of cross-linkage. By controlling these variables, silicones can be produced in a wide variety of physical forms, including fluids, greases and compounds, varnishes, resins, and rubbers.

In all of their various forms, silicones combine many of the most desirable properties of inorganic and organic materials. For example, inorganic materials such as mica, glass, and quartz are resistant to heat, and they have excellent dielectric properties, but they are brittle and hard to fabricate. Organic materials such as rayon, rubber, and plastics are tough, flexible, and easy to fabricate but they are unable to withstand heat or extreme cold. From their inorganic origins, silicones inherit stability and dielectric properties; the organic groups impart flexibility, water repellency, and ease of handling. This unusual combination of properties in silicone fluids, greases, electrical insulating varnishes, and resins accounts for their usefulness in almost every industry.

"Silastic" is the name coined to describe silicone rubber, produced by the author's company. It is a descriptive name because Silastic combines the stability of the silicones with the elastic properties of rubber. It represents a whole family of rubbery silicone materials. These synthetic silicone elastomers are flexible and resilient. Like natural and synthetic organic rubbers, they can be stretched or distorted. The silicone rubbers are distinguished, however, by a retention of rubber-like properties at temperatures far above and below the serviceable limits of natural or synthetic organic rubbers.

The thermal stability which makes silicone rubber unique among elastic materials is inherent in the silicone polymer. It is not a property obtained by special compounding. All types of Silastic will withstand continuous exposure to at least 300 F. They will withstand intermittent exposure to temperatures in the range of 300 to 500 F. The same formulations that show such high-temperature stability are also useful at temperatures as low as —110 F. Certain silicone rubbers are serviceable, therefore, over a temperature span of 600 deg or about twice the temperature span covered by organic rubbers.

The silicone elastomer, usually a dimethyl silicone, is compounded with inorganic reinforcing fillers such as silicon dioxide, titanium dioxide, zinc oxide, and ferric oxide. Since the silicone-rubber polymer contains no points of unsaturation, the vulcanization or cross-linking required to develop rubbery properties is accomplished by special vulcanizing agents and subsequent oven heating. This process involves relatively long periods of oven curing, but the fully cured parts are completely free of unsaturation and therefore are remarkably resistant to ozone and oxidation.

Silicone-rubber stocks can be fabricated like organic rubbers with conventional rubber-handling equipment. Many different silicone-rubber stocks and pastes are commercially available. Most of them are fully compounded and ready for molding, extruding, coating, calendering, or laminating. The stocks can also be dispersed in a solvent and applied as a coating by spraying, dipping, or brushing. Solvent-free silicone-rubber pastes are also available for coating, laminating, calking, or sealing. Sponged silicone-rubber products are produced by special techniques.

Various silicone-rubber formulations offer a wide choice of physical and dielectric properties. Specific gravity ranges from 1.2 to 2.5. Fabricated and cured stocks and pastes cover a durometer A scale range of 35 to 95. Tensile strength ranges from 300 to 750 psi. Ultimate elongation covers a span of 40 to 300 per cent. The brittle point varies from —90 F to less than —165 F. Compression set measured after 22 hr at 300 F varies from 10 to 90 per cent in the various stocks and pastes.

Those familiar with the properties of natural or synthetic organic rubbers will note at once the relatively low tensile strength and ultimate elongation values obtainable in silicone rubber. Tear and abrasion resistance are also relatively poor at room temperature. In almost all of the applications for which silicone rubbers are recommended, however, room-temperature values are of academic interest.

The most important single feature of silicone rubbers is that these semi-inorganic elastomers retain essentially the same physical, chemical, and dielectric properties at temperatures cold enough to change other rubbers into brittle solids and at temperatures hot enough to melt or embrittle other rubbery materials. This relative indifference to temperature extremes is demonstrated by a measurement of properties at both high and low temperatures, as well as by a measurement of properties before and after aging for long periods of time at high temperatures.

For example, the hardness values of three representative types of Silastic, measured at temperatures ranging from —110 to +480 F are shown graphically in Fig. 1. Silastic 250 has a hardness at —70 F of 53, and a hardness measured at 500 of 42. Over a temperature span of 570 F, the hardness of this silicone rubber changes only 11 points on the Shore A scale.

THERMAL STABILITY OF SILASTIC

All types of Silastic are serviceable at temperatures in the range of 300 to 500 F and upward, with brittle points ranging from less than —70 to —130 F. Thermal stability is also ap-

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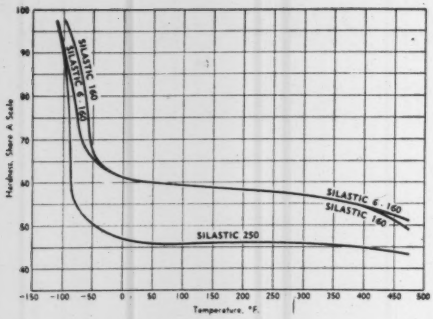


FIG. 1 HARDNESS OF SILASTIC MEASURED AT VARIOUS TEMPERATURES

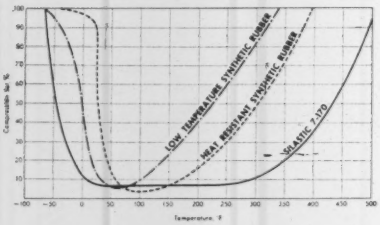


FIG. 2 COMPRESSION SET AT TEMPERATURES FROM —70 TO +500 F

parent in the remarkable resistance of Silastic to permanent deformation under load at high temperatures. Relative resistance to compression set is demonstrated by data plotted in Fig. 2. In one of the low-compression-set Silastic stocks, compression-set values, measured at —70 F after 22 hr under load at that temperature, are about the same as compression-set values measured in the same way at —10 F on a synthetic organic rubber compounded to meet AMS 3205 B for low-temperature flexibility. Compression-set values, measured on the same Silastic stock at 450 F, are comparable to the compression set measured at 325 F on a synthetic organic rubber, compounded to meet AMS 3202 C for dry-heat resistance.

The thermal stability of Silastic is most conclusively demonstrated by a comparative study of the effects of accelerated thermal aging on the properties of various Silastic stocks and some of the most heat-stable synthetic organic rubbers. As demonstrated in Fig. 3, a heat-stable synthetic organic rubber becomes a brittle solid after 1 day at 300 F. Silicone rubber is still soft and flexible after 90 days at 390 F. This relative stability is better demonstrated by plotting physical properties against days of aging at 390 F, as in Figs. 4 and 5.

These studies indicate that after 60 times as much aging at 390 F the tensile product (tensile strength times elongation divided by 1000) in parts fabricated of Silastic will be in the range of 10 to 20 times the tensile product of parts fabricated of one of the most heat-stable synthetic organic rubbers. After 24 hr in an air-circulating oven at 390 F, the organic rubber becomes a brittle solid with an ultimate elongation of less than 5 per cent. The Silastic samples are still rubbery with elongation ranging from 50 to 125 per cent after 60 days at 390 F, or 30 days at 480 F. The direction of the curves indicates that further aging at these temperatures will result in relatively little additional change in physical properties.

RESISTANCE TO WEATHER, OILS, AND CHEMICALS

The utility of Silastic is not limited, however, to abnormally high or low-temperature applications. Test data show that Silastic also has excellent resistance to weathering and lubricating oils. Outdoor aging tests in progress now for more than 2 years show that the combined action of sunlight, oxygen, and moisture has very little effect on silicone rubber. Test samples show no change over a period of 2 years even when stretched or flexed. Data on changes in the physical properties of two typical silicone rubbers after $3^1/_2$ years of aging in central Michigan are shown in Fig. 6. Hardness increased less than 10 points; tensile strength decreased only 12 per cent; elongation was an average of 31 per cent below the original values. There was no visual change in the samples; no evidence of cracking or surface checking.

As in the case of other rubbers, the oil resistance of Silastic depends upon the aromatic content of the oil. Silastic shows good resistance to oils of high aniline point or low aromatic content. Oil resistance is good even at 350 F. Silicone rubber is widely used, therefore, as a gasketing material in internal-combustion engines. The resistance of silicone rubber to oils of high aromatic content is not so markedly superior to that of oil-resistant, synthetic, organic rubbers.

The chemical resistance of silicone rubbers varies from stock to stock. In general, silicone rubbers are resistant to bases, weak acids, salt solutions, oxygen and ozone, to the lower alcohols and oxygenated solvents, and to oils. They are not resistant to aromatic solvents, the lower hydrocarbons, or steam.

DIELECTRIC PROPERTIES

Silicone rubbers meet most of the requirements of an ideal dielectric. They combine the remarkable heat stability and moisture resistance of resinous silicone insulating materials with most of the desirable properties of rubber, including resilience, shock and abrasion resistance, and resistance to both mechanical and electrical fatigue. In some of the silicone-

FIG. 3 HEAT-STABLE ORGANIC RUBBER BECOMES A BRITTLE SOLID AFTER 1 DAY AT 300 F, WHILE SILICONE RUBBER IS STILL SOFT AND FLEXIBLE AFTER 90 DAYS AT 390 F

rubber compounds no significant change in dielectric strength, power factor, or dielectric constant can be measured from —30 to 480 F. This is in sharp contrast to organic insulating materials that deteriorate rapidly with increasing temperatures until they become conductors rather than dielectrics.

More important is the fact that aging at high temperatures does not change materially the dielectric properties of silicone rubbers recommended for electrical applications. For example, the dielectric strength and the dielectric constant of typical Silastic stocks at 100 cycles per second remained practically unchanged after 4 months of accelerated aging at 350 F. The relative constancy of the dielectric strength of a Silastic electrical insulating tape aged at 250 C (482 F), Class A cloth aged at 150 C (302 F), and Class B materials aged at 175 C (347 F) is shown in Fig. 7.

The arc resistance of silicone rubber is high compared to organic dielectrics. Arc-resistance values for typical formulations are in the order of 200 to 250 sec. Silastic is also highly water-repellent and retains high surface resistivity even under adverse conditions. After exposure for 2 months to moisture condensing conditions at 100 F, a typical formulation had a surface resistivity of 10^{12} megohms. Exceptional resistance to corona is demonstrated by the fact that cable insulated with silicone rubber shows no signs of deterioration after 2200 hr under test conditions that cause organic rubbers to fail in 3 to 30 min.

In addition to all of these advantages, thermal conductivity of various silicone-rubber stocks is about twice as great as that of either organic or resinous insulating materials. Coils filled with silicone-rubber paste and then wrapped with an outer jacket of silicone-rubber tape have been built to operate under the same load at a temperature as much as 50 per cent below the temperature of identical coils vacuum impregnated with electrical insulating varnishes. This means that silicone rubber can be used to double the power per pound ratio of electric machines, as well as to multiply life and increase reliability under adverse conditions.

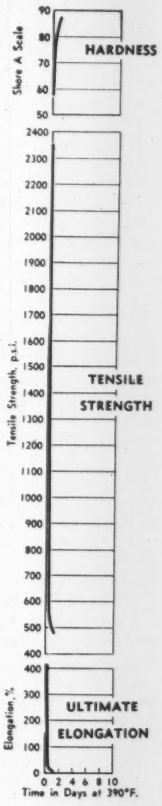


FIG. 4 EFFECT OF AGING AT 390 F ON THE PROPERTIES OF A HEAT-RESISTANT ORGANIC RUBBER

LIMITATIONS OF SILASTIC

However extraordinary the properties of Silastic may be, it has, like any other engineering material, certain limitations that should be called to the reader's attention.

One of the most obvious limitations of Silastic is its price. Finished parts may cost several times as much as comparable parts made of organic rubber.

It should be pointed out, however, that Silastic is not designed to replace natural or synthetic organic rubbers where those materials give satisfactory service. Therefore it is not directly competitive with organic rubbers at temperatures in the range of —40 to 200 F, unless weather and oxidation resistance, resistance to certain oils and chemicals, or dielectric properties are of primary importance.

Silastic is normally used to do a job that no other rubber-like material can do. In such applications, price becomes relatively unimportant in relation to savings in maintenance costs and improved performance and reliability. In many cases the use of Silastic simplifies design and reduces production costs so much that the price of the material is negligible.

Another limitation of Silastic is its relatively low tensile

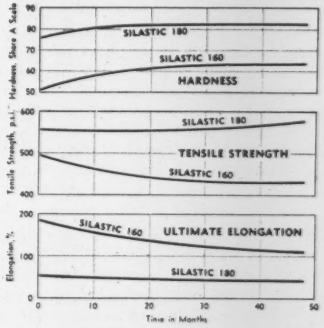


FIG. 5 EFFECT OF AGING AT 390 F ON THE PROPERTIES OF SILASTIC

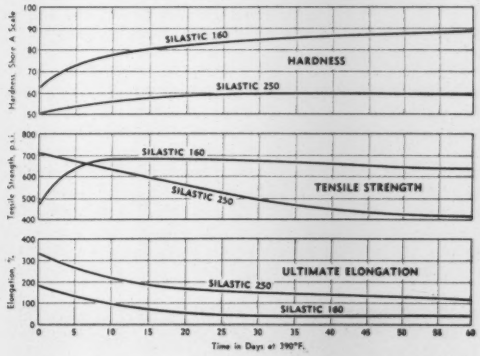


FIG. 6 EFFECT OF WEATHERING ON THE PROPERTIES OF SILASTIC (ASTM D518-44, methods A and B.)

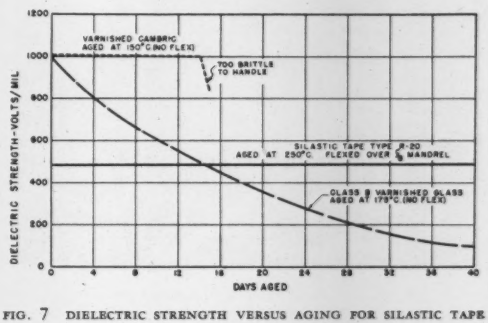

VARNISHED CAMBRIC AGED AT 150°C (NO FLEX)
TOO BRITTLE TO HANDLE
SILASTIC TAPE TYPE R-20 AGED AT 250°C FLEXED OVER ½ MANDREL
CLASS B VARNISHED GLASS AGED AT 175°C (NO FLEX)
DIELECTRIC STRENGTH-VOLTS/MIL
DAYS AGED

FIG. 7 DIELECTRIC STRENGTH VERSUS AGING FOR SILASTIC TAPE AND CLASS A AND CLASS B INSULATING COMPONENTS

strength, tear resistance, ultimate elongation and abrasion resistance at room temperature. Those limitations are being overcome, in part, by new formulations such as Silastic 250, which has over twice the mechanical strength of the earlier silicone-rubber stocks. Furthermore, the lack of mechanical strength, abrasion, and tear resistance is more apparent than real because properties measured at room temperature give very little indication of performance under actual service conditions.

After brief exposure to temperatures that cause very little change in the physical properties of Silastic, for example, organic rubbers become brittle solids or soft gums lacking resilience, elongation, and flexibility. For that reason, organic rubbers have more strength and elasticity than are required for many applications, even in the temperature range of —40 to 200 F. If flexibility rather than elongation is required, Silastic can be reinforced easily with fabrics of woven glass or metal to give maximum tensile strength and tear resistance.

APPLICATIONS

The following examples are given to suggest some of the operating conditions under which silicone rubbers have proved to be most useful. Rocker-box gaskets of silicone-rubber-coated glass cloth have been standard equipment on Pratt and Whitney's 28-cylinder Wasp Major aircraft engines for more than 4 years. These gaskets, illustrated in Fig. 8, withstand hot oil at operating temperatures up to 450 F. The maintenance costs in commercial airline service have been reduced by the exceptional stability of these gaskets in contact with hot oil, and by their resistance to compression set.

Silicone-rubber O-rings are used to seal the lower cylinder liners and water ports on Diesel-electric locomotive engines. The seals come in contact with hot oil and water. Because of high resistance to compression set and nonhardening characteristics, these seals prevent the leakage of water into the oil compartment. They have reduced maintenance costs substantially by giving 9 times the life of organic-rubber O-rings.

Silicone rubber reinforced with glass cloth is widely used to construct and seal aircraft heating, deicing, and ventilating ducts. The problem was to simplify the design and increase the life of heating and ventilating systems. Typical operating conditions include maximum temperatures of 450 F, operating temperatures up to 400 F, misalignment as much as $\frac{1}{4}$ in., and extreme vibration. Flexibility at temperatures as low as —90 F is also required.

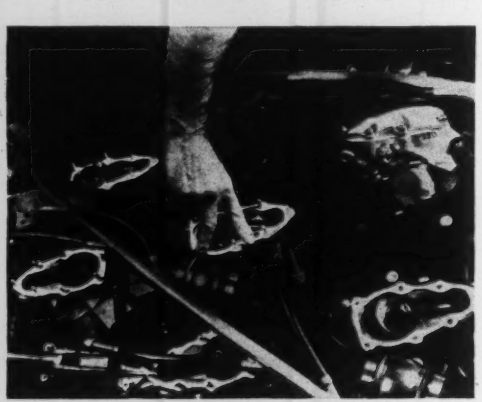


FIG. 8 ROCKER-BOX GASKETS OF SILICONE-RUBBER-COATED GLASS CLOTH ON PRATT AND WHITNEY 28-CYLINDER WASP MAJOR AIRCRAFT ENGINE

FIG. 9 BOOT MOLDED OF SILICONE RUBBER USED ON AIRCRAFT LIMIT-CONTROL SWITCH

Silastic seals are used to seal bomb-bay doors, and camera-bay doors and windows. These seals retain their strength and resilience at temperatures ranging down as low as —100 F. Sponged Silastic acts as a cushion seal between side blisters, landing-gear doors, and between flaps and wings. All these silicone-rubber parts are operated at —100 F without breakage.

Boots molded of silicone rubber are used to increase the reliability and to prevent the corrosion and shorting of the aircraft limit-control switches shown in Fig. 9. Flexibility at —100 F is required.

Push-rod housing seals of silicone rubber remain soft and pliable after more than 1000 hr in contact with hot oil. On these airplane engines, operating temperatures range up to 450 F. Records show that the use of these silicone-rubber seals will eliminate over 90 per cent of the flight delays previously caused by leakage of oil around the push rods. Maintenance cost and the hazard of oil leakage are also reduced. Silicone O-rings are also used to seal the push-rod-tube assemblies on air-cooled ordnance vehicles.

Silicone-rubber strips are used to damp the vibration and prevent breakage of the aluminum cooling vanes on the cylinders of aircraft engines.

Silicone-rubber diaphragms are used in the compressors that supply air to the brakes of Diesel-electric trains. At operating temperatures of 350 F, these silicone-rubber diaphragms last for several months, compared with an average service life of 1 day for organic-rubber diaphragms.

Silicone-rubber gaskets and seals are used in domestic steam irons because they retain their resilience at temperatures up to 500 F for the normal service life of the iron.

Resistance to weathering and stability at both high and low temperatures are demonstrated in the use of Silastic gaskets to seal outdoor floodlights. The organic rubbers previously used for this purpose melted and hardened, allowing moisture

to enter the socket and making it impossible to change the bulb twithout replacing the gasket. Because the silicone-rubber gaskets retain their rubberlike properties, shape, and resilience, they maintain a waterproof seal in spite of outdoor weathering and heat given off by the lamp. They can be re-used many times.

In a chemical plant, nickel safety disks are exposed to ammonia formaldehyde at 240 F. They lasted only 1 day. When coated with silcone rubber, their life was increased to 3 months.

Silicone-rubber rings are used to seal fluid transmission units on automobiles. These Silastic seals are used because they have superior resistance to the hydraulic oil used at operating temperatures of about 350 F.

A number of companies are using silicone-rubber pads on machines for heat-sealing plastic foil and films at temperatures in the range of 350 F.

Crimped tubing, fabricated of Silastic-coated glass cloth, bonded with Silastic adhesive, and coated with a silicone resin for added stiffness, is serviceable after 200 hr at 750 F and 90 hr at 1000 F.

Silastic-covered rolls are used in the hot or cold-dip coating of fabrics, plastic film, and metal sheeting or foil.

Silastic-coated pressure plates, backing bars, or press pads are used in printing or sealing plastic packaging materials and in making plywood.

Silastic is used in many miscellaneous applications, ranging from low-temperature pushbutton covers and hose to heat-stable and nonadhesive surfaces for molding and conveying candy.

Silastic is extensively used as a dielectric material because of its high thermal conductivity and heat stability. It is used in producing shipboard intercommunication cable on which specifications require operation even after 3 hr in direct contact with a gas flame.

Because of the resistance of silicone rubber to chlorinated diphenyls, capacitor bushings are made from this material.

Spark-plug caps for automotive use are being fabricated of silicone rubber. These caps keep condensed moisture from interfering with the operation of the spark plugs. Silicone-rubber-insulated ignition harnesses for planes and ordnance vehicles are now in production.

To reduce static and corona discharge, all of the connections to aircraft antennas were once spliced and taped individually. That labor was eliminated and static was reduced as much as 90 per cent through the use of special fittings. Equipped with Silastic seals, these fittings retain their dielectric properties and exclude moisture and foreign matter even after long exposure to outdoor weathering. Silastic pastes and special stocks are used to embed coils and strip heaters. Heating elements molded into sheets of silicone rubber are in commercial production for a number of aircraft applications. There are also many potential applications for such heating surfaces in household appliances.

The development of semivulcanized Silastic tapes, reinforced with glass cloth, has increased greatly the usefulness of silicone rubber as an insulation material. These tapes are used as outer wrappings for field coils, armature and transformer coils, and solenoids. When heated, these semivulcanized tapes form a resilient, void-free, moistureproof, and water-resistant jacket. This jacket has high thermal conductivity, and is stable at temperatures ranging from —70 to +500 F.

CONCLUSION

In general, silicone rubber is most useful where the service life of organic rubbers is limited by abnormally high or low operating temperatures. It has also been used to simplify constructions that were originally complicated by the lack of thermal stability in organic rubbers. Typical of such applications are the use of silicone rubber to seal automotive transmission units, chlorinated diphenyl-filled capacitors and push-rod-tube assemblies in aircraft and in air-cooled ordnance engines Silicone rubber is also used in place of more complicated or less efficint metal constructions to seal high-altitude-aircraft doors and to prevent breakage by damping the vibration of the cooling vanes of aircraft engine cylinders.

Furthermore, silicone rubber meets most of the requirements of an ideal dielectric. It combines the remarkable heat stability and moisture resistance of resinous silicone (Class H) insulating materials with the most desirable properties of rubber, including resilience, shock and abrasion resistance, and resistance to both mechanical and electrical fatigue.

Silicone rubber is still an elastomer, however, and it cannot be expected to do more within its wider operating temperature span than organic rubbers can do within their narrower span.

Neoprene Applications in Engineering Design

(*Continued from page 632*)

ment for lead sheath in some types of underground cable. Resistant to cutting and tearing, unaffected by galvanic action or the corrosive effect of acid or alkaline soils, this new construction is proving superior to its predecessor in many ways. In weatherproof wire, aerial cable, and telephone drop wire, a protective covering of neoprene has allowed simplified constructions to be adopted and has resulted in superior performance even in extreme climates. Neoprene also has been used to replace the braid and lacquer on automobile ignition cable because of its superior resistance to ozone, heat, and oil. The inherent flame resistance of neoprene, accentuated through proper compounding, is insuring safer operation in coal mines where neoprene compositions are used as a protective sheathing over the trailing cable which provides power for mining machinery.

Protective clothing and gloves made of neoprene-coated fabrics are widely used in the chemical and petroleum industries to assure adequate protection of workers. Corrosion-resistant neoprene coatings have given excellent performance in fume ducts, blowers, pickling and plating baths, filter presses, and many other types of equipment under a wide range of service conditions.

Similar coatings, applied by brushing or spraying, are used to protect the laminated-plastic-radomes of jet planes against rain erosion.

In the printing industry, because of their stability and resistance to ink vehicles and washes, neoprene compositions have been used for inking rolls and offset blankets to replace composition or rubber rolls. Many other types of industrial rolls for use in the textile, paper, and metals industries are made of neoprene.

Vibration isolators, flexible couplings, and shock mounts made of neoprene are widely used where resistance to oils, heat, and ozone is required. For example, aircraft and automotive engines are mounted on neoprene vibration isolators; delicate instruments and mammoth punch presses rest on neoprene shock mounts.

Many other types of products, such as diaphragms, grommets, gaskets, coupling rubbers, stoppers, valve disks, and so forth, make use of the unique combination of properties which can be obtained with neoprene.

CENTRIFUGAL CASTING *of* PIPE *in* SAND-LINED MOLDS

By K. R. DANIEL

CHIEF ENGINEER, AMERICAN CAST IRON PIPE COMPANY, BIRMINGHAM, ALA. MEMBER ASME

EARLY HISTORY OF PIPE MAKING

BEGINNING with the crude clay pipe of early Babylonian days, 4000 years B.C., there has been a constant effort to reach the ideal—a pipe that would endure underground.

There is no definite knowledge as to when and where the first iron pipe was made. It may be assumed, however, that it followed closely upon the development of, or was produced coincidently with the cannon, the earliest mention of which is found in the yearbook of the City of Ghent, dated 1313.

An old German catalog of a pipe manufacturer relates that cast-iron pipe was used in the water system of Dillenberg, Germany, in 1455. Cast-iron pipe laid at Longensalya, Germany, in 1562 is still in use today—a service record of 385 years. In 1661 cast-iron pipe was installed for water service at Braunfels, Germany. When replaced in 1932 with larger pipe, the original pipe, after 271 years, was in excellent condition.

Authentic records of cast-iron underground water-conduit installations reveal that several lines of various diameters were laid, by order of Louis XIV, near Paris, France. These were to carry water from the reservoirs of Picardy to those of Montbauron and, together with a spring-water conduit, to supply the town and parks of Versailles. In all, a length of about 26,000 ft were manufactured and laid between 1664 and 1688, or about 275 years ago.

All of these lines consist of 3 1/4-ft pipe lengths, joined by means of bolted flanges. They are of considerable weight and still serve their purpose satisfactorily.

The few repairs which have been required have generally been necessitated by the bad condition of the flange bolts which have rusted out.

The pipes were cast horizontally. The flange joints were made with a thick lead gasket, sometimes as much as 7/8 in. thick. The system is under a considerable pressure.

As early as 1744 the Chelsea Water Company of London, England, laid a 12-in. flanged cast-iron pipe which was relaid in 1791 because of the joints "being perished." It was the engineer of that water company, Thomas Simpson, who designed the first bell and spigot pipe. This was about 1785, at which time an experimental section of pipe was laid with lead and jute joints, which proved so successful that the entire system of all the London companies were gradually relaid with bell and spigot cast-iron pipe, the uninterrupted service record of which now covers 135 to 160 years. This bell and spigot design of joint is still the accepted standard for most cast-iron water mains.

In 1804 the Watering Committee of Philadelphia decided to import from England a small quantity of cast-iron pipe to be laid as an experiment. This was bell and spigot pipe in 9-ft lengths. In so far as is known this was the first cast-iron pipe laid in the United States.

In so far as is known the first cast-iron pipe was molded in wooden frames, or flasks, packed with sand sufficiently moist to retain its shape, and the pipe was cast in a horizontal position or "on side." This was the only method of casting pipe for over 300 years, and is still used for casting short lengths of pipe. But as the standard of length increased from about 3 ft to 6 ft, then to 9 ft, and later to 12 and 16 ft, the position of the casting molds changed from horizontal to a slope, and finally to the vertical position.

The first cast-iron pipe made in America was produced in a foundry at Millville, N. J., in 1834. The pipe was cast horizontally, or on side in 6-ft lengths.

The pit-cast vertical method of production was developed by the Links Foundry in 1846 at Montrose, Scotland. This method gradually replaced the horizontal method of all pipe longer than 9 ft.

VERTICAL PIT-CAST PIPE

The change to the vertical method was made in order to secure a more uniform thickness of wall and better distribution of metal, as well as to insure cleaner and stronger castings by bringing all dirt or slag (which rises and floats on the heavier metal) to the top of the mold into a larger runner which is broken or cut off. In 1854 the first pit-cast foundry in America was built in New Jersey for the production of pipe in 12-ft lengths. From that time on the production of pit-cast pipe in America was rapidly enlarged. Fig. 1 shows a sectional view of a pit-cast mold.

The most important feature of the pit method of production consists of one or more large pits, either circular, semicircular, or rectangular in shape and about 12 to 16 ft deep, filled with iron flasks accurately machined and fitted for the various sizes of pipe. These flasks are made in two pieces, loosely hinged together on one side, and with flanges for clamping the halves together when closed. The inside diameter of the iron flasks is several inches larger than the outside of the pipe pattern, which is also of iron, accurately turned and polished. This pattern has a tapered bottom end which rests in a correspondingly tapered seat in the center of the "Ramming Stool" on which the flask is placed for molding. Thus centered, the space between the pattern and the flask is filled with sand and thoroughly "rammed."

The pattern is then withdrawn and the mold washed on the inside with a liquid "facing." The mold is then placed over an oven where it is dried, and from whence it takes the name of "dry sand mold."

The core is made on a hollow mandrel, or "bar," perforated throughout its entire length, the holes being 1/8 to 1/4 in. diam. The bar has accurately turned spindles in each end, which rest in horizontal bearings in which the bar is placed parallel with a metal-edged board, or "strike," the edge of this strike fixing the diameter of the core.

Contributed by the Production Engineering Division and presented at the Spring Meeting, Atlanta, Ga., April 2–5, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

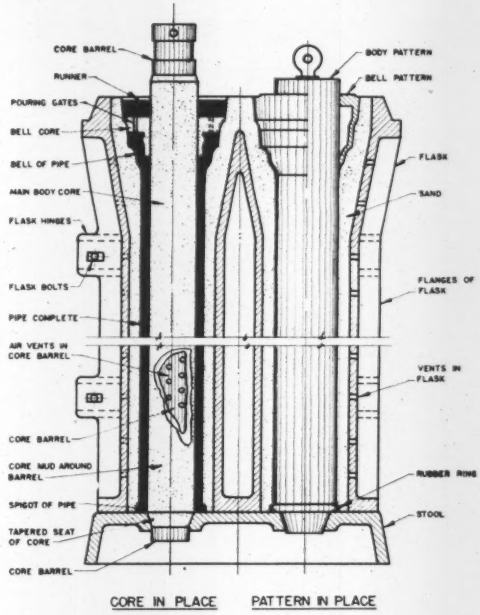


FIG. 1 SECTIONAL VIEW OF PIT-CAST MOLD

While being slowly revolved, a covering of combustible material is first placed on the bar, either in the form of rope made of hay or excelsior, or of paper in the form of pulp, and this is followed by a roughing coat of loam of the consistency of a stiff mortar gaged as to thickness by the metal-edged strike. These cores are placed in ovens where this first coat is dried, and then covered by a finishing coat of loam and a coating of liquid facing, and again placed in the drying ovens.

When both molds and cores are dry, the cores are set in the vertical molds resting on "casting stools" with a corresponding taper which centers the core at the bottom. The head core, or runner core, with holes or "gates," for the metal, which is made separately from the main core, is then placed in the top of the mold, thus centering the main, or body, core at the top. A deep runner, or reservoir, is made on top of the mold, which is then ready for casting.

Within a few seconds, after the pouring is finished, the metal in the pipe is "set" and the bar can be drawn out and used again for the next cast.

This method, which came into being in 1834, was universally used until the early 1920's and is still in use for the casting of very large-diameter pipe.

CENTRIFUGAL CASTING OF PIPE

The most outstanding development in the pipe industry took place about 1922. Two new centrifugal processes marked a radical departure from the established methods of on side and vertical pit casting—the metal-mold process and the sand-lined-mold process.

In 1922 the author's company started the development of the process of centrifugal casting of pipe in sand-lined molds, and during the three years that followed the process was perfected.

In 1923 a small production unit, consisting of four machines making a 12-ft pipe in 4 and 6-in. sizes was completed and operated through 1925, manufacturing a salable product, income from which aided in defraying the cost of development.

In 1926 the No. 1 Mono-Cast Centrifugal Shop was built, consisting of 12 machines for making pipe in 3 through 12-in. sizes in 16-ft lengths. This shop, with 25 years of constant improvement, is the present-day pipe-producing unit, 3 through 12-in.

In 1930 the No. 2 Mono-Cast Centrifugal Shop was built for sizes 14 through 24 in.—it was later modified to include 14 through 48 in., all in 16-ft lengths.

Mono-Cast is the trade name for cast-iron pipe made centrifugally in refractory-lined molds by the author's company. The name is derived from the fact that all portions of pipe are cast simultaneously.

RAW MATERIALS

The ordinary grades of pig iron, cast iron, and steel scrap, found in the district are used, and as there are no gates or risers, the amount of return scrap is negligible. Standard by-product coke is the melting medium used in converting the iron to the fluid state. Dolomite is the flux. The sand required for making the refractory molds is a medium-coarse synthetic sand which is bonded by ordinary yellow field clay. The strength requirements and processing of this sand will be dealt with later. The sand, when rammed in the flask, is faced with ordinary pipe-foundry facing, made from floured coke with water and clay added.

The sand used for making the socket cores which form the inside of the bell is a very fine washed silica sand to which a cereal binder and core oil is added before baking.

Tar and cement used for coating the pipe are the only other raw materials required.

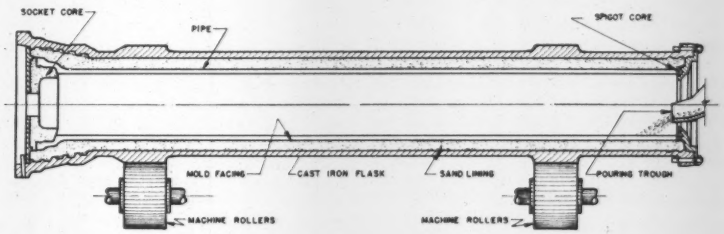


FIG. 2 SECTIONAL VIEW OF CENTRIFUGAL MONO-CAST PIPE IN SAND-LINED MOLD

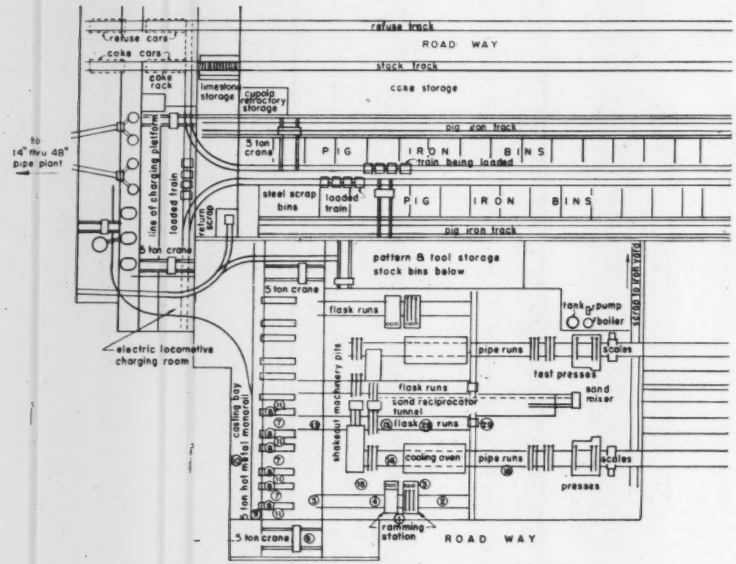


FIG. 3 SCHEMATIC PLAN OF PIPE FOUNDRY

EQUIPMENT REQUIRED

Mono-Cast pipe is of unit construction, that is, one pipe to the flask. The flask, which is made of cast iron, is machined on all points so as to make it possible to do rapid duplicate work. It is necessary to ram the sand mold perfectly concentric with the spinning bands of the flask. See Fig. 2.

As shown in the schematic plan of the plant, Fig. 3, there are two 3-way ramming stations at the position designated as No. 1. The empty flasks come down the run, as indicated at No. 2, and are received on a tilting table in the run which delivers them into the vertical position on the ramming stations, as shown at No. 3. The flasks are handled three at a time, and these two ramming stations are used to alternate the work so that while the men are ramming on one station, the other station can complete its molds and make the flask change.

Once the flasks are in the vertical position and properly located on the ramming stools, the three patterns are lowered into the flasks. These patterns are handled from above by a stationary pattern hoist. The ramming is accomplished by use of special pneumatic rammers running at the rate of 600 strokes per min and using an air pressure of 100 psi. The rammer is connected to the ramming foot by an 18-ft stem. The whole is supported by a counterweight on the end of a cable.

The ramming time depends upon the size of the mold and the size of the sand stream. It varies from 1 min 10 sec to 1 min 30 sec. Each flask is revolved at a speed that will allow a layer of sand approximately $3^1/_2$ in. thick for each revolution of the mold. The hardness of the mold is governed by the thickness of this layer of sand. The thickness of the sand between pattern and flask is approximately 2 in. for all sizes.

The patterns are drawn three at a time from the molds. The molds are then lifted off the ramming stools by a hydraulic lift and the facing applied to the mold while in the vertical position. The flasks are then returned to the horizontal position by the tilting table and are ready to move forward on the skin-drying run, position 4, by conveyer, to the casting bay, Fig. 4.

As the molds proceed down the run they are skin-dried to a depth of $^1/_8$ to $^3/_{16}$ in. by gas torches firing into each end alternately. This skin drying requires about 4 min moving the molds from position 4 to position 5. Just before reaching position 5 the spigot core is placed in the mold and held in place by a bolted plate. At position 5 the molds are picked up by an overhead crane No. 6 and delivered to the casting machine at No. 7. In this operation the flasks are handled two at a time by a special device attached to the crane.

At position 7 the top half of the casting machine shown at No. 8 is elevated to sufficient height to allow the mold to roll in sidewise. The machine is then closed and the flask rotated by driving the casting-machine rollers. The two sets of rollers, see Fig. 2, are driven by a 50-hp variable-speed motor through V-belts. The proper weight of iron has previously been poured into the casting-machine ladle No. 9 from a bull ladle carried on a 5-ton monorail crane No. 10. This iron is poured into the mold while it is rotating at approximately 40 rpm.

As soon as the iron is in the mold the flask is accelerated to casting speed in about 10 sec. Casting speeds vary with the diameter and thickness of the pipe, from as high as 1700 rpm on a light 3-in. pipe to 336 rpm on a heavy 48-in. pipe. In general, the speed produces a centrifugal force of 75 lb.

During this spinning operation any slag, loose sand, or other foreign matter which is lighter than the iron, form on the inside surface of the pipe. This produces a sound, close-grained casting, free of inclusions and gas pockets, and since all portions of the casting are formed simultaneously, casting strains are not set up.

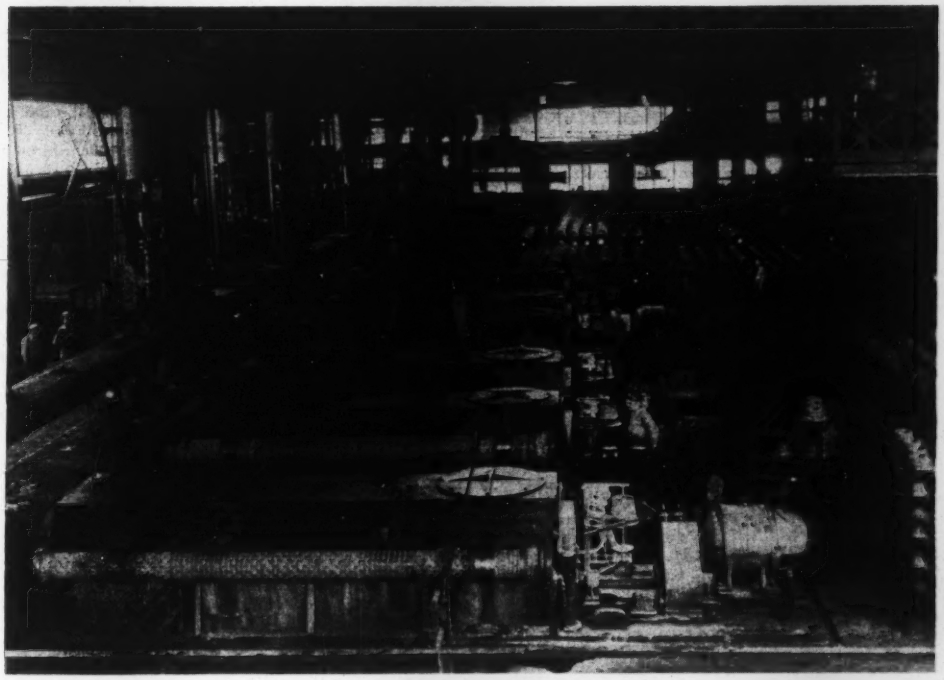


FIG. 4 VIEW OF CASTING BAY SHOWING CASTING MACHINES, FLASK-HANDLING CRANES, AND STRIPPER RUN

After the pipe has been spun a sufficient length of time for the iron to solidify—this time varies from 3 min on a 3-in. pipe to 30 min on a heavy 48-in. pipe—the machine is shut down, the hood raised, and the flask rolled out on the opposite side at No. 11. This entire casting procedure is automatic once the operation is set in motion. From this station it is moved to No. 12 by the overhead crane where the head-core and spigot-core plates are removed from the flask and the socket-core sand knocked out of the bell end of the pipe. All of the foregoing operations have taken place in less than 10 min.

The flask with the sand and pipe in it now passes to the stripping machine, shown at No. 13, which is a three-flask machine built on a 37-deg incline. The flasks are placed on a tilting table and tilted to the incline, in which position they are clamped to prevent their rotating during the stripping operation. A revolving tube with a special cutter is advanced into the flask at the rate of 20 fpm, cutting the sand between the pipe and flask. The flasks with the pipe in them are returned to the horizontal position by the tilting table and the pipe puller No. 15 removes the pipe from the flask and deposits it at No. 16. This run is covered by a hood which prevents too rapid cooling. From this run the pipe is lowered by an elevator to the cleaning department, run No. 18. The first station in the cleaning department thoroughly cleans the bell and spigot ends of the pipe, brushing and grinding away any sand adhering to the surface. The sockets and spigots are gaged and metal thickness checked here. At the next station the inside of the pipe is cleaned by grinders entering from each end. This cleaning operation removes all impurities, such as slag and sand, and leaves the pipe with a smooth inside surface. Grinders are used because they have been found most effective in removing the dross.

The next station is the hydrostatic test press at which all pipe are subjected to 500 lb pressure. From here they pass to the washer where high-pressure nozzles thoroughly wash the pipe. After leaving the washer, the pipe destined for water service are run through the pipe heating oven where they are brought up to about 350 F before dipping in tar. A large percentage of these pipes for water service are coated with tar on the outside only and a thin coating of cement applied to the inside by centrifugal force, much as the pipe itself is cast. This coating is known as enameling, and gives a high coefficient of flow. This thin cement inside coating was developed by the author's company and is now offered by all members of the Cast Iron Pressure Pipe Institute.

Pipe which are to be used for gas by-pass the heating and coating operation and are put through the air-test press where they are placed under 50 psi while submerged in a liquid which will not cause the pipe to rust when placed on the yard as water would. From these stations the pipe are stenciled with the trade-mark of the company and weighed, the weight being stenciled on each pipe. From the scales they go to the yard where after a final inspection they are loaded for shipment.

Other operations which take place in the cleaning department are drilling of the flange boltholes in mechanical-joint pipe and a thorough inspection to see that each pipe meets the specification desired by the customer.

From Station No. 13 the empty flasks proceed down the

run to No. 28 and then to transfer car No. 29 which returns them to flask run No. 2, where they proceed through the ramming station again in their regular turn.

SAND REGENERATION

The sand required to make centrifugal pipe is special. It must have sufficient green bond to withstand rough handling by the cranes and vibration in the casting machines. It must have sufficient strength not to wash when several thousand pounds of iron are poured onto it. And it must be open enough to vent thoroughly. It must break down easily in the stripper. Its fusion point must be high to prevent burning. As stated before, this is a synthetic sand. It is made from a medium-coarse sharp sand, yellow field clay, and return sand. Its green bond is approximately 11½ lb, moisture 7.6 per cent, permeability 90, dry bond 90 to 110 lb, see Fig. 5.

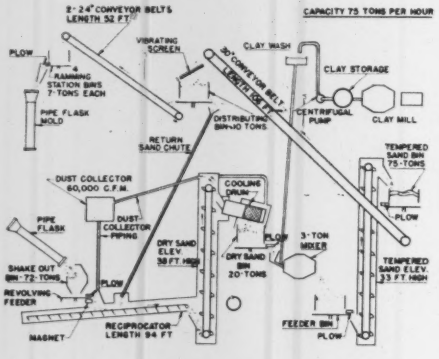


FIG. 5 SCHEMATIC PLAN OF SAND MACHINERY

The sand which is cut from the flask by the stripping machine falls by gravity into the 72-ton shakeout bin, from which it is plowed off onto the reciprocator conveyer after passing over an electromagnet which removes the tramp iron. The reciprocator conveyer delivers the dry sand to an elevator which carries it up to the cooling drum. Both the shakeout bin and the cooling drum are tied into the dust collectors—this removes a considerable portion of the fines from the sand. From the cooling drum it falls into the dry sand bin, from which it is plowed as needed into the mixer. Bond in the form of clay wash and water are added. From the mixer it goes into the feeder bin up the tempered-sand elevator to the tempered-sand bin, then by a 30-in. conveyer belt to a vibrating screen, which aids in the mixing and aerates the sand as it falls into the distributing bin. From the distributing bin the sand is divided to each side of the shop by 24-in. conveyer belts which take the sand to the ramming-station bins, from whence it goes into the molds. At the distributing bin constant check analysis is run on the sand. At this point the last moisture is added to the sand which has been run on the dry side up to this position to prevent the sand arriving at this advanced point too moist. The sand travels a distance of approximately 460 ft from shakeout to ramming station. In addition to the check analysis run in the shop constantly, several samples are sent each day to the laboratory for complete analysis—dry strength, green strength, grain size, moisture.

The iron for making the pipe is stored in the bins, Fig. 3, according to its analysis. The charges are made by a magnet crane in boxes of 5500 lb each, which are carried on tram cars and pulled by an electric locomotive. These charges, when made up, are weighed by running the car over platform scales. The boxes or charges are then moved under the charging crane. This crane handles all iron, coke, and dolomite which are charged into two cupolas.

No labor is required on the charging platform because of a special charging machine hydraulically operated by the charging-crane operator from valves which can be reached from his crane cab. Two boxes, or 11,000 lb, make up the charge of iron.

The coke and limestone are charged in similar boxes and in the same fashion.

One link-shaped hot-blast cupola, 72 × 102 in., is operated to furnish iron for the No. 1 shop, and one 72-in. round hot-blast cupola to supply iron to the No. 2 shop.

The link-shaped cupola is capable of melting 35 tons an hour with today's coke. From this cupola, which runs continuously throughout the day, the iron is poured into a 7-ton forehearth which aids in producing a uniform analysis. The cupola's melting rate is controlled by the blast pressure which, in turn, is controlled by a variable-speed motor operated from a point near the forehearth or mixing ladle. On this control board are instruments for recording blast temperature, volume, and pressure. The analysis run for No. 1 shop is 1.20 silicon, 3.40 carbon. From the 7-ton forehearth the iron is carried in bull ladles by a 5-ton monorail crane to the casting machines. Optical pyrometers are used extensively at the cupolas and the casting machines to check the temperatures of melting and casting. Control tests are run throughout the day. A chill sample is poured on the first three ladles and each half hour afterward. Chemical analyses are run on first and last ladles and each two hours throughout the heat. A routine spectrograph analysis is run each day to check for tramp alloys.

Test bars are poured each three hours.

In addition to the routine tests which have been mentioned throughout the process, the following tests are made to maintain the quality of the pipe:

A strip ½ in. wide × 12 in. long is cut from the wall of a pipe which is cast on the first ladle of each heat, and from a pipe cast every three hours thereafter throughout the heat. These strips are tested as a beam on 10-in. supports and must stand a minimum modulus of rupture of 40,000 psi.

Pipes, based on number cast, are tested to destruction by bursting. The number selected varies from one in 5000 on 4-in. pipe to one in 300 on 48-in. pipe. These pipes must stand a minimum bursting tensile of 18,000 psi.

From each 100 pipes 14 in. through 24 in. and each 50 pipes 30 in. and larger a 10½-in-long is cut off the end of the pipe and tested in crushing. Its minimum modulus of rupture must be 40,000 psi.

One pipe per month 3 in. through 12 in. is subjected to an impact test, and one pipe per month 3 in. through 12 in. is tested as a full-length beam, its minimum modulus of rupture being 35,000 psi.

CONCLUSION

The history of pipe is the history of civilization. Great cities could not exist without the modern water and gas distribution systems consisting largely of cast-iron pipe.

The most efficient transportation systems in the world are the underground water and gas pipe lines.

The railroads of the United States have approximately 404,000 miles of railway tracks. The water and gas distribution mains in the United States, largely cast iron, total up to 1,000,000 miles.

Take a Broad View of the SCOPE *of* YOUR PROFESSION

By A. P. ADAMSON

AERONAUTIC AND ORDNANCE SYSTEMS DIVISION, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y. JUNIOR ASME

WHERE is the boundary between electrical engineering and mechanical engineering? Your attitude on this question will have a profound effect on your future progress as an engineer and on the future growth of the mechanical-engineering and electrical-engineering professions. I am going to try to convince you that there is no boundary.

It is apparent that the answer to this question is important to you. For instance, it will help you determine what jobs you should regard as yours and what jobs you should feel are really outside your legitimate field of interest. Furthermore, if there is really no boundary, you can feel free to attack any problem that appeals to you.

OVERLAPPING FIELDS OF MECHANICAL AND ELECTRICAL ENGINEERING

A great many young mechanical engineers seem to come to work in industry with their minds already made up on this important point. Their attitude can be expressed as follows: "If electricity is involved in the problem, it is outside my field of interest." This attitude leads to trouble for the young engineer since it is not true. It is not true because of the fact that whether we like it or not, electricity is here to stay. It has in fact been adopted by nearly all industries so that go where you will you are confronted with electrical apparatus and problems.

Consider for instance the machine-tool industry. A few decades ago machine tools were driven by belts from line shafts. All feeds and stops were mechanical in nature. Automatic cycling was by means of cams. The machine-tool industry was a mechanical engineer's paradise.

But what has happened? The tools are now driven by individual electric motors. In fact many motors may be used on one machine. Several types of variable-speed motor drives are used. Electric control has been adopted in some cases. The machine-tool engineer of today must be familiar with electrical apparatus, its uses, care, and application. But at the same time he must still be familiar with the hydraulic, pneumatic, and other mechanical equipment so that he can select the best equipment for each application.

Consider the railroad industry. Time was when the steam locomotive was king, and practically no electrical equipment was used. Today the steam locomotive is being rapidly displaced by the Diesel-electric or the electric locomotive. Electrical signaling is used and there is even some talk of the adoption of radio for communication purposes. Yet the mechanical problems are still much in evidence, and the engineer must be familiar with both electrical and mechanical apparatus.

The aircraft industry is another good example of one requiring a combination of abilities in its engineers. Wind tunnels are largely operated electrically, and a wide variety of electrical instruments and controls are used. Complex electrical instrumentation is used in flight testing and, in fact, in normal flight. Electrical strain gages are widely used. Electrically operated automatic pilots are used. Here too, the electrical problems are closely intermingled with hydraulic, pneumatic, and other mechanical problems, so it is essential that one engineer be familiar with both electrical and mechanical devices and problems.

A wide variety of present-day manufacturing industries use electrical processes of one type or another. For instance, there are electric furnaces, induction heating, dielectric heating, various types of electric welding, electrical instrumentation and control systems, and electrically controlled tools and processes. The modern mechanical engineer must have a good knowledge of all of these devices with which he has to deal.

The control and instrumentation industry utilizes an enormous variety of electrical and mechanical devices, often with many different devices all working together in a system. If you should chance to work in this industry, you will be faced continually with problems in which electrical and mechanical principles are tightly interwoven.

We might as well face the fact that the electrification of industry requires the mechanical engineer to become interested in electrical problems.

A great many modern branches and products of industry today slice right across many branches of engineering. What kind of an engineer would you hire to design a gyroscope? Perhaps a mechanical engineer. But he would have to become thoroughly familiar with electric-motor design and electrical or photoelectric indicator design.

WHAT KIND OF AN ENGINEER WOULD YOU HIRE?

What kind of an engineer would you hire to design a vacuum tube or to design vacuum-tube manufacturing equipment?

What kind of an engineer would you hire to design a television receiver? And what kind of an engineer would you hire to redesign it for low-cost production? How can he do his job if he does not know how the set operates?

What kind of an engineer would you hire to design a hydraulic control valve to give a hydraulic fluid flow proportional to an electric current?

What kind of an engineer would you hire to design an aircraft automatic pilot? And what kind of an engineer would you hire to decide whether the automatic-pilot power actuator should be electrically, mechanically, hydraulically, or pneumatically operated?

What kind of an engineer would you hire to develop and design the electrohydraulic control system for a jet engine or the control system for a chemical plant?

What kind of an engineer would you hire to help in the design of an electric locomotive, or in the design of a control system for a Diesel-electric locomotive?

What kind of an engineer would you hire to design a guided

Presented at the Members and Students Luncheon, during the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Mr. Adamson received the 1950 Pi Tau Sigma Gold Medal Award for outstanding achievement in Mechanical Engineering within ten years after graduation. He was graduated from the University of Southern California in 1941.—EDITOR.

missile or a gunfire control system or a machine-tool control system?

The answer to all these is obvious. You would try to hire an electromechanical engineer. And since you couldn't find one, you would hire either a mechanical engineer or an electrical engineer and hope for the best.

BASIC ELECTRICAL KNOWLEDGE A NECESSITY

The attitude that if electricity is involved, I'm not, is unsuited to an engineer who works in industry. Even if he should find a job which has not been contaminated by the introduction of electrical apparatus, he should be on the lookout constantly for ways to do his job better. And some of these ways may happen to involve electrical apparatus.

Likewise, he should be on the lookout for ways whereby his mechanical tricks and methods can replace electrical devices in use elsewhere. He cannot do this intelligently unless he has a good knowledge of electrical principles and is willing to keep informed concerning progress in both electrical and mechanical fields.

The alert mechanical engineer can also find ways of contributing to the advance of knowledge in traditionally electrical fields if he is willing to take the trouble. His different training and background may enable him to see solutions to problems which the electrical engineers have not yet solved. However, he cannot do this without a good knowledge of electrical principles.

We have seen some of the problems associated with the attitude, "If it involves electricity, I'm not interested in it." I suggest the following as being a much more constructive and realistic attitude: "I don't know where the boundary is between electrical engineering and mechanical engineering, and I doubt if there is one."

If we adopt such an attitude, we must realize that the mechanical engineer must know almost as much electrical engineering as does the electrical engineer. The gaining of this knowledge is not as difficult as might be expected. In fact the EE courses in college can provide you with most of this knowledge. The rest can be picked up after graduation, if you are willing to do some more studying. What is important is to decide that as the information is needed in your work you are willing to dig it out.

This decision to be an electromechanical engineer will also require that you do more reading of trade journals so as to keep abreast of the developments in all fields of interest to you.

Once you have admitted that the mechanical engineer is legitimately interested in electrical matters, you can work productively and profitably on a wide variety of jobs which otherwise would be closed to you. You will not be confused or lose your self-confidence because you are surrounded by a jungle of electrical apparatus.

You can make certain that electrical apparatus is used when warranted and not used when not warranted in your work. It isn't safe to leave this up to the electrical engineers. They will electrify everything if you let them.

You will be able to co-operate intelligently with the electrical engineer and make an occasional contribution to his field of endeavor.

ELECTRICAL COURSES IN COLLEGE VITALLY IMPORTANT

In spite of all good reasons to the contrary, many mechanical engineers still hold the view, "If electricity is involved, I'm not." Why is this view so prevalent? It probably gets its start in our colleges where the student sees that the EE and the ME departments are physically separated and he can choose to study EE or ME. He does not realize that this separation is artificial and that it has outlived its usefulness.

The student takes a few courses in EE but he is not made to realize how important they are to him. I remember that my EE courses were intesting and instructive but I took them only because they were required and not because I ever expected to use them.

Furthermore, the colleges do not make the student realize that there are a great many electromechanical devices which involve EE and ME principles closely intermingled.

Another source of this attitude of "No electricity for me," may be the fact that we have two separate and partially competing national societies. I won't dwell on this subject, however.

The long-range way to cure this incorrect attitude on the part of the young mechanical engineer is now obvious. Our college courses in EE and ME should be combined into one electromechanical-engineering course. Such a procedure would benefit students of both groups. It is a rare student, indeed, who knows what sort of a job he will have ten years after he gets out of college. Accordingly, the best course of instruction is one which acquaints him thoroughly with the fundamental laws of nature and of human nature, and the tools with which these laws can be applied. He would then be better fitted for that unknown job in an unknown field in an unborn industry.

NEW FIELDS FOR THE ELECTROMECHANICAL ENGINEER

Imagine if you can how many engineers are employed today in the jet-engine, guided-missile, radar, and atomic-energy fields. These industries were virtually nonexistent ten years ago. I have known electrical engineers who spend all of their time on structural-design problems, and mechanical engineers whose occupation is the design of electronic amplifiers. Such instances indicate the futility of specialization in college and indicate some of the gains to be expected if EE and ME courses are combined.

So please see what you can do to have them combined.

It will probably take a while for you and me to put this long-range program across. Therefore we must have a short-range program as well to solve this problem of the mechanical engineer who doesn't believe he is interested in electricity.

You can regard your EE classes as a real, integral, and important part of your ME course of study. In fact, they may be more important to you than most of your ME courses since there are fewer of them to cover a wider field.

You can start thinking of yourself as an electromechanical engineer. This will enable you to build up the proper mental attitude so that you won't start quivering all over when faced with the necessity of incorporating a vacuum tube in a piece of equipment you are designing.

You can continue studying after graduation to fill in the gaps in your education as they become obvious to you.

If you take these steps, I'm certain that you will become better and more useful engineers.

Long-Term Business Outlook

(Continued from page 626)

making will survive efforts to convert it into a socialist or planned economy.

"What's Ahead For American Business" is written for the general reader and, in particular, for the business man. Though the conclusions are optimistic, unpleasant facts and possibilities are not brushed aside. Though the language is simple and nontechnical, the discussion is not superficial. Many basic issues are raised. The book is well worth reading by all who wish to understand more about the principal forces shaping the economic future of America.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

U. S. Boilers—New Frontiers

HIGHER standards of living, greater industrial expansion, and the opening of new frontiers in 12 countries on four continents and two island groups outside the United States, are implicit in an announcement of foreign sales of steam-generating equipment by The Babcock & Wilcox Company, New York, N. Y.

Whether in pioneer settlement or modern young city, the addition of this American-made equipment will mean increased power, the first step in self-sufficiency, for such places on the other side of the world as South Africa, Egypt, Israel, North Persia, Borneo, and the Philippines, as well as countries in the Western Hemisphere, including Mexico, Brazil, Columbia, Venezuela, Peru, and Uruguay.

Countries all over the world, coming in contact with the equipment of our Armed Forces during the past decade, have been impressed with American technical knowledge. Consequently they have looked to this country for heavy machinery and equipment, particularly equipment for the manufacture of power and process steam.

Their acquisition of the latest American design in steam-generating equipment represents a remarkable advance when it is realized that present equipment, except in a few northern European countries, is on a level with that used in the United States around 1920. While 30 years ago only 70 per cent of the energy put in as fuel was absorbed by the boiler and the rest lost in the stack, today the highest type of unit recovers 92 per cent of the total energy.

With the arrival of steam-generating equipment, people living in remote outposts have, for the first time, the convenience and safety of electric light and power in place of their primitive lamps and man-driven machines. The development of local industries will create jobs and money to buy some of the necessities and luxuries which they cannot produce themselves. Enlightenment, education, and better health go hand in hand with improved living standards.

A variety of industries, aided by the use of this steam-generating equipment, are being established or expanded by various countries to develop their natural resources, such as the mining of lead, copper, and zinc at a settlement 900 miles inland in Southwest Africa, the refining of oil in Suez, Egypt, and Balik Papan, Borneo, and the manufacture of soap from the oil of cotton seeds and the development of rubber in Sao Paulo, Brazil.

Some places are building up new local industries to replace former imports. For instance, sugar mills springing up over Columbia, Venezuela, and Peru will produce sugar formerly imported from the West Indies. Designed to make the most of environmental factors, the boilers in these mills will burn the empty stalks and leaves of the sugar cane, known as bagasse, instead of other hard-to-obtain and costly fuel, such as oil or coal.

Another development of local products is illustrated by the pulp and paper mills of the Union Corporation, Ltd., at Natal in Zululand, and at Springs, near Johannesburg, South Africa. For pulp these mills use the eucalyptus tree, prolific in their localities. The company has also begun to plan a type of vine, something like the southern pine of the United States, which in South African climate grows so rapidly that in seven or eight years it reaches a sufficient maturity to be used for pulp, as compared with the 15-year growth necessary in the United States.

Besides the boilers obtained for power generation, these two plants will be supplied with black liquor recovery units—equipment developed by Babcock & Wilcox by means of which waste chemicals resulting from the cooking of wood pulp for the making of paper are recovered to be used as fuel in the pulping process.

In Israel two boilers now being manufactured by B&W will go into two pioneer industries. One is for process steam in a new textile plant of The Arlind Corporation in the thriving young city of Ramat-Gan. The other is for the Israel Ytong Corporation's plant in modern Haifa which makes a lightweight concrete block. As the use of this block reduces considerably the amount of structural steel needed, it is making possible the construction of office buildings at the rate of about one story a day. The boilers in the Haifa plant produce steam for use in the driers.

The conversion of natural resources has led to the unique use of three other boilers at Kuwait on the North Persian Gulf.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Here, when one drills for water, only oil comes up, so His Highness Sheikh Al Salim Al Subah is building a town water supply plant to evaporate water for drinking from the Persian Gulf.

Aeronautical Research

THE 1951 Biennial Inspection of the NACA Langley Aeronautical Laboratory, held recently at Langley, Va., afforded interested key executives and engineering personnel from industry an opportunity to receive firsthand reports of recent progress in aeronautical research at Langley. Demonstrations of some of the special facilities and methods used at Langley were also witnessed by the group. Visits were made to the new 16-ft high-speed wind tunnel; the pilotless aircraft research division; flight research laboratory; the 4 × 4-ft supersonic pressure tunnel; the 11-in. hypersonic tunnel; the 7 × 10-ft wind tunnels; internal aerodynamics laboratory; loads calibration laboratory; structures research laboratory; vibration and flutter laboratory; and the gust tunnel. High lights of the inspection follow.

TRANSONIC TUNNELS

The NACA, it was reported, has placed in operation two large tunnels, as well as smaller ones, which are capable of providing accurate aerodynamic information about flow conditions in the full transonic range. Transonic test sections are now being installed in other large tunnels.

The largest of the transonic wind tunnels currently completed is the 16-ft tunnel at the Langley Laboratory. The 8-ft transonic tunnel at Langley was the first of these new large research tools to be completed and placed in operation. Throughout the entire transonic speed range, air flow through the test section is as accurate as can be maintained in modern tunnels designed for use on aerodynamic problems in other speed ranges. Tunnel air speed can be held precisely or varied smoothly through a Mach number of 1.

One of the models which has been installed in the 16-ft transonic tunnel for correlation purposes has been a quarter-scale X-1, so instrumented that as many as 200 pressure-distribution readings from the loading over the wing can be recorded simultaneously. Using models of this size, it may be possible to gather sufficient experimental information for analysis to permit development of mathematical and theoretical understanding of transonic-flow phenomena.

The drive for the 16-ft transonic tunnel consists of two 30,000-hp motors connected by 60-ft shafts to the fans. These counter-rotating fans have an aerodynamic efficiency of 95 per cent.

In addition to aerodynamic study of airplane and missile models in the transonic speed range, the tunnel will be used in the investigation of high-speed propeller characteristics. A 6000-hp propeller dynamometer can be installed in the test section of the tunnel, permitting testing of high-speed and supersonic-type propellers at large scale up to low supersonic speeds. Both aerodynamic and vibration characteristics of such propellers will be surveyed.

PILOTLESS AIRCRAFT RESEARCH

In the pilotless aircraft research division the visitors learned that for the past 6 years extensive use of rocket-propelled free-flight models launched from the ground has enabled the research scientist to gather quickly large amounts of varied information about aerodynamic behavior in the transonic and supersonic ranges. For some time these rocket-model techniques have been a principal source of large-scale transonic and supersonic information.

The firing of these rocket-propelled models is done at Wallops Island, a sparsely settled area located on the Atlantic Ocean near the Maryland-Virginia state line. The models to be tested are instrumented in the Langley Laboratory and then taken to the Wallops Island firing area where both radar tracking and telemeter recording are used to gather information during flight.

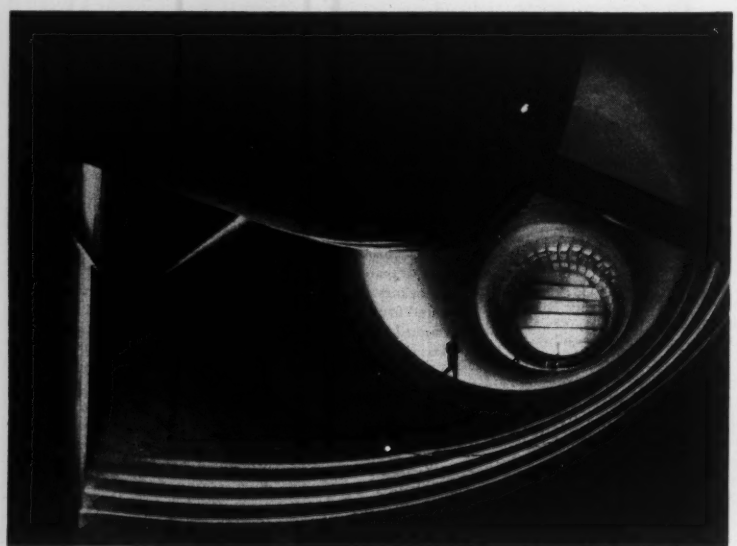


FIG. 1 INTERIOR VIEW OF LONG AIR RETURN PASSAGE IN THE 16-FT TRANSONIC WIND TUNNEL AT LANGLEY AERONAUTICAL LABORATORY GIVES AN IDEA OF THE SIZE OF THIS GIANT STEEL TUBE

Solid-propellant-type rockets are used to obtain the speeds required. The models usually contain an internal rocket which is ignited after a booster rocket has brought the model part way up to speed. The largest rocket in current use produces about 6000 lb of thrust and can accelerate a 130-lb model to a Mach number of 1.5 in 3 sec. The booster rocket must be designed to separate from the model under tests after it is fired without disturbing the model.

The research models vary in complexity depending on the type of test being made. Where only drag or control effectiveness is being studied, simple models can be used with little or no instrumentation.

In the more complicated

FIG. 2 A RESEARCH MODEL WITH SHARPLY SWEPT WINGS TAKES OFF FROM THE LAUNCHING STAND AT THE NACA'S PILOTLESS AIRCRAFT RESEARCH STATION ON WALLOPS ISLAND, VA.

studies, the model is equipped with a transmitter, various instrument pickups, and a mechanism for deflecting the elevator in a programmed pattern of flight.

RESEARCH AIRCRAFT

However, despite continued development of the accuracy and versatility of laboratory techniques, ultimate verification of information gained from the use of such research tools can be obtained only by actual flight-proving of the data in full-scale airplanes, it was pointed out in the Flight Research Laboratory. In addition, there are problems related to loads, dynamics, and operation, which can best be attacked by flight tests with full-scale airplanes. Some of these problems can be isolated for study in flight.

In the study of transonic problems, specially designed and instrumented airplanes provide valuable information. The research airplane program, in which the Air Force, the Navy, the aviation industry, and the NACA are participating, continues to be productive of good results, according to Langley reports.

The Douglas D-558-I and II, Bell X-1, Northrup X-4, and the Convair XF-92A are currently being flown at Muroc Dry Lake, Calif., to carry out intensive research on transonic-speed problems.

Satisfactory operation of an all-moving tail during transonic flight requires a system capable of positioning precisely the control surfaces. Usually a power boost system for the controls is needed because of the very high aerodynamic forces involved, and the NACA is investigating the general design requirements of such booster systems, especially with respect to the handling qualities of airplanes. An airplane, equipped with a control boost and simulated feed system, is being used in flight studies of the several difficult problems involved. Already this work has shown the need for reducing friction existing in the slide valves of power boost systems.

Because of the high speeds which tomorrow's tactical airplanes may be expected to attain, attention is being given to the problems of automatic flight controls. Such automatic systems, responsive either to the wishes of the pilot or a ground operator, can be studied effectively only by actual flight research.

SUPERSONIC SPEED PROBLEMS

Information about aerodynamic behavior in the supersonic range is a matter of immediate need both for missiles and high-speed airplanes, and the NACA's large faster-than-sound tunnels are being used intensively to provide such data. The Langley 4 × 4-ft supersonic pressure tunnel, with an operating Mach number range from 1.2 to 2.2 and variable density to permit attainment of large-scale results, is particularly adapted for research on both supersonic airplane and supersonic missile shapes.

One phase of the work done in this tunnel utilizes complete missile models in the study of wing-body interference, downwash, inlet characteristics, stability factors, and other basic problems of current interest. Instrumentation, connected to outside-the-tunnel recording apparatus through the sting-type model mount, includes a six-component balance. The control surfaces of the model can be controlled electrically, and mass flow through the inlets can be varied to simulate full-scale operation under varying conditions.

A second phase of this experimental research which also is closely connected with missile work involves study of the effects of scale on the skin-friction drag characteristics. The desirability of maintaining laminar boundary layers as a means of reducing drag has long been recognized. The attainment of laminar layers at subsonic speeds has been found impracticable in the majority of cases; however, Langley engineers say that research results indicate that conditions more favorable to the maintenance of laminar flows may exist at supersonic speeds.

HYPERSONIC RANGE STUDIES

In certain types of long-range missiles, most effective performance is obtained by operation at high altitudes and Mach numbers in the range of 5 to 10 and even higher in the Langley 11-in. hypersonic tunnel.

At hypersonic speeds, it has been determined, shock waves are swept back close to the model, and the boundary layer becomes thick. Whereas at moderate angles of attack at subsonic speeds lift is derived largely from the upper surface of a wing, at

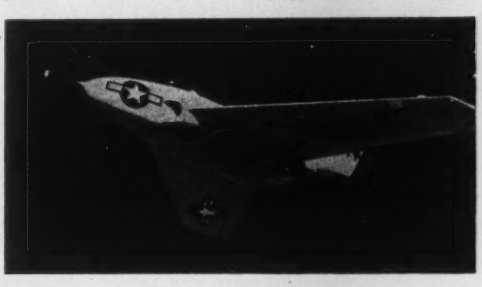


FIG. 3 FIRST FLIGHT PHOTOGRAPH OF THE NORTHRUP X-4, FLYING-WING-TYPE RESEARCH AIRPLANE, OVER THE CALIFORNIA DESERT NEAR MUROC AIR FORCE BASE

hypersonic speeds the largest part of the lift is derived from the lower surface. At the same time, the influence of the three-dimensional tip flows becomes smaller until at hypersonic speeds this influence is so small that use of wings with extremely low aspect ratio appears to be practical. Even though lift-drag ratios are low, they are sufficient to permit horizontal flight at high altitude at hypersonic speeds. At these speeds more of the load can be carried by the lift derived from the body as distinguished from the lift coming from the wings.

The boundary layer grows at a much faster rate at hypersonic than at lower speeds. The thick boundary later changes the surface, thus altering the effective wing or body shape. This problem is of considerable importance at Mach numbers of 7 on slender shapes suitable for missile use, and will assume even greater importance as the Mach number is increased still further.

WING-WAKE PROBLEMS STUDIED

The flight behavior of airplanes, particularly at high angles of attack, is complicated by the interaction of the various parts. A tail assembly located behind the wing, for example, is affected by the wing wake. This condition affects not only the static stability of the airplane, but also the damping of oscillatory motion.

To aid in studying the air flow behind a wing, a tuft grid setup has been developed for use in one of the Langley 7 × 10-ft tunnels. Consisting of a steel framework on which fine wires are strung with equal spacing both vertically and horizontally, the grid has wool tufts attached to the intersections of the wires.

Cameras, either still or motion, are located far downstream in the tunnel to take pictures of the tufts in a vertical plane. In regions of undisturbed flow, the tufts show in the pictures as small dots. In regions of downwash and sidewash, the flow pattern is clearly shown by the tufts.

INLETS FOR SUPERSONIC AIRPLANES

As in the design of other airplane parts for efficient operation in the transonic speed range, serious new problems are introduced respecting the air inlet of a power plant for this speed range. Most important of these for the inlet are drag and pressure recovery.

Research in the Internal Aerodynamics Laboratory has shown that an open nose inlet can be designed for high subsonic speeds which will be useful through the transonic range to low supersonic speeds. At higher speeds, however, a strong detached shock develops ahead of the relatively blunt nose of the inlet, causing excessive loss in available engine pressure as well as excessive drag.

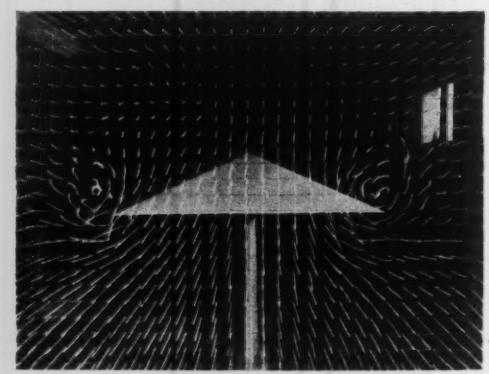


FIG. 4 A WIRE GRID WITH WHITE WOOL TUFTS, PLACED IN THE WAKE OF A DELTA WING MODEL IN THE NACA'S 7 × 10-FT WIND TUNNEL AT LANGLEY AERONAUTICAL LABORATORY, PROVIDES A GRAPHIC PICTURE OF TURBULENCE BEHIND EACH WING TIP

For flight at higher speeds, air inlets clearly must be designed especially for supersonic flow and great emphasis is being placed on inlet research covering such speed ranges, with new problems present as well as the older ones.

One promising solution is the side inlet, to the study of which considerable research effort has been devoted. Utilizing the rather complete information which the NACA has acquired on supersonic nose-inlet design, the approach has been to split the nose inlet for mounting in the sides of the fuselage. Unless a by-pass is provided so that a sufficient quantity of boundary-layer air can be removed, the ram pressure recovery losses are great. With such a by-pass, however, ram recovery can be restored to a value nearly as high as that for the nose inlet.

AIRCRAFT LOADS INVESTIGATED

Aircraft loads research is being conducted in the Loads Calibration Laboratory by means of theoretical investigations, wind-tunnel measurements of loads on airplane models, and flight measurement of loads on models as well as on full-scale airplanes. Still another method involves the use of a machine which makes fatigue tests on full-scale aircraft structures.

First, the machine applies a steady load, corresponding to that imposed on an airplane in steady flight through smooth air. Then, oscillating loads of 16 different amplitudes are superimposed on the steady load. The sequence of the amplitudes and the number of oscillations at each amplitude are established in advance, enabling study of complicated load patterns which can, for example, match the statistical distribution of rough air loads.

Loads may be determined by means of measurements of acceleration, pressure, and deflection. Accelerometers are useful in measuring the over-all airplane loads and inertia loads. Pressure distributions over the wing, tail, and fuselage determine not only the total load on the surface but the distribution of load over the surface. Deflection measurements by means of small electric wire resistance strain gages help in determining the loads induced by elastic deformation.

HIGH-TEMPERATURE MATERIALS

Much research is being conducted in the Structures Research Laboratory on the suitability of materials for use in airplanes and missiles that will be subjected to the high temperatures associated with supersonic speeds. One criterion for such use is the ability of the material to withstand yielding, or stretching beyond permissible limits, at the higher temperatures which are experienced.

Aluminum alloys currently used in aircraft lose almost all their strength at 600 F, according to Langley engineers. Titanium alloy and stainless steel seem to hold up much better at such high temperatures, they said, and stainless steel seems to be much better than titanium, although when compared on the basis of strength per unit of weight, the differences are less pronounced. Titanium is better on a strength basis for use where intermediate temperatures will be experienced.

In the bending of a compression structure like the plate elements in the upper skin of a wing, the full material strength often cannot be realized because the skin tends to wrinkle when the skin is thin. This wrinkling can occur long before the material itself has been stressed to its capacity. After wrinkling occurs, the plate elements still can take load but their

maximum strength no longer is directly related in a simple way to strength of the material. In order to provide a basis of material selection for such cases, research has been conducted to determine the correlations between the strength of the structural elements and the yield strength of the material.

If the consideration of weight is added to the foregoing factors, of the materials compared, stainless steel is to be preferred at temperatures above 800 F, and the titanium alloy is superior in the intermediate temperature range. At lower temperatures, any one of the three materials might be most efficient, depending upon the particular design conditions. A general conclusion is that no one material is universally superior, but that the choice of a material depends not only on the temperature consideration but also on the structural use to which it will be put.

Another field of structures research is fatigue, where repeated stressing of material may eventually cause it to fail. Why materials fail by fatigue is not yet known, but many factors affecting the fatigue life of structures are now understood. For example, fatigue failure generally starts in the vicinity of so-called stress raisers such as holes, notches, or fillets which disrupt the uniform flow of stress. Such an increase over uniform stress is called the stress concentration factor. The relation between it and fatigue life is effected by the size of the specimen, an effect which has been evaluated for steel, and now is being studied with aluminum alloys.

Supersonic Wind Tunnels

A 180,000-HP wind-tunnel drive—reported to be the greatest power output ever to be concentrated on a single shaft—is included in General Electric equipment ordered recently by the National Advisory Committee for Aeronautics.

The giant electric-motor unit and a companion 110,000-hp drive will be installed in two supersonic wind tunnels at NACA's Ames Aeronautical Laboratory, Moffett Field, Calif.

The 180,000-hp installation will be used to power a new, record-breaking eight-foot tunnel which will create wind velocities several times the speed of sound.

The drive will consist of four, 45,000-hp, 720-rpm variable-speed a-c induction motors mounted in tandem on a single shaft to drive either of two axial-flow compressors.

Largest of their kind ever built, the motors will weigh more than 145 tons apiece and each will be the size of a small room. Rated at 180,000 hp, the four-motor drive will have a peak one-hour output of 216,000-hp, according to G-E engineers. The system will use slip-regulator control.

The second unit, rated at 110,000 hp, will be used at the Ames Laboratory's present 16-ft tunnel, replacing the 27,000-hp G-E drive installed there a few years ago.

Using three propellers operating on a single shaft, this tunnel will create wind velocities ranging from 350 to 920 mph.

This drive will be composed of two 41,500-hp and one 27,000-hp variable-speed a-c induction motors. Combination slip-regulator and Clymer System speed control will be used.

The Clymer setup will consist of two motor-generator sets linked in for greater speed control and to provide easier starting without excessive drain on the power supply.

All-Weather Jet

A NEW more powerful all-weather turbojet engine, the J-47-21, was introduced by the General Electric Company at the recent annual convention of the Aviation Writers Association in New York, N. Y. The company said it incorporates all the best features of the J-47 engine as proved in thousands of hours of service, plus the results of imaginative engineering thinking supported by advanced research and testing.

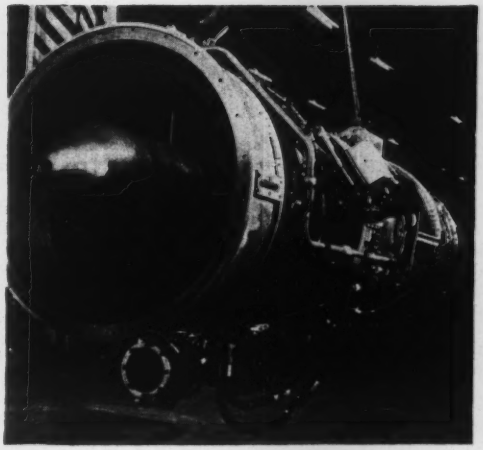


FIG. 5 GENERAL ELECTRIC COMPANY'S LATEST TURBOJET ENGINE, THE J-47-GE-21, IS THE FIRST OF THE ADVANCED J-47 SERIES AND IS DESIGNED FOR ADVANCED MILITARY AIRCRAFT

Although its power could not be revealed, it puts out far more thrust than the present J-47 which is rated in excess of 5200 lb.

The J-47-21 turbojet is the first of the company's "Advanced J-47" series to be announced.

Neil Burgess, Jr., Jun. ASME, assistant manager of engineering of the G-E Aircraft Gas Turbine Divisions, said the "21" is an all-weather engine with anti-icing features and high-altitude starting characteristics. It may be equipped for either water/alcohol injection or afterburning for greatly added thrust power for short periods. A tailpipe variable jet nozzle may be added to obtain maximum efficiency.

Mr. Burgess described the advanced J-47 as a product of engineering, forward-looking development, and research.

These are the three basic tools which give more thrust than previously achieved in a given amount of space, plus the added benefit of lower fuel consumption, he noted.

He said the company is also working on other new engines including the XJ-53 which cannot be further identified.

Mr. Burgess told the writers that the advanced J-47-21, which is 36.75 in. in diam and 146 in. long, was developed in record time—18 months from the time the drawings were under way until 50-hr tests were completed.

The engine has a so-called "cannular" type of combustion system consisting of a single combustion space containing individual "cans." Some accessories, housed in the nose in current production engines, have been placed underneath to provide a greater air-inlet area to the compressor. The compressor—which forces air in great quantities to the combustion chambers—combines high air flows, high pressure ratios, and high efficiency with a minimum number of stages.

Mr. Burgess said the turbine is connected directly with the compressor. The basic engine control is a hydraulic system, which proved itself on other model G-E engines. Exhaust temperatures are controlled electrically. The oil is cooled by engine fuel and is contained in a tank on the engine.

"Hot noses," achieved by bleeding hot air from the compressor to hollow nose parts, and retractable air-inlet screens are used to prevent ice collection on these critical inlet parts.

With modification of accessory mountings, and other minor changes, the "21" will become the J-47-GE-29. Addition of afterburner forms the J-47-GE-31.

Long-Distance Rocket Flight

A ROCKET that could go to the moon and other planets was termed a "marginal possibility" in a recent address by Anthony J. Nerad of the General Electric Research Laboratory, before the New York Section of the American Chemical Society. He said that the greatest factor in making such extremely long-distance rocket flight possible, with fuels now available, would be a rocket built in stages. Mr. Nerad said there would be several sections, which would drop off one by one after fuel is used.

However, the scientist warned, still more development is required to make such rockets a reality. Even by taking advantage of all known techniques to extract from propellants the best possible performance, we still have not attained the real margins needed for very long-range terrestrial rockets or those which we can send to the planets, Mr. Nerad said.

We thus come to a stopping point, he pointed out, where we must consider admitting that our future lies in the use of atomic fuel, or else we must conceive of an easier or necessary intermediate step.

Even assuming solution of the general problems of applying atomic energy to produce power, the great concentration of energy in this sort of fuel imposes a difficulty in utilizing it in rockets, Mr. Nerad said. It might be capable of discharging the exhaust gases, which push a rocket through space, at enormous speeds. This in itself is a source of inefficiency, unless the rocket itself moves at comparable speeds, which are far greater than any now contemplated, he said.

As an example, he cited the V-2 rocket, for which the fuel cost is about $500. The gases are shot backward at about a mile a second. When the rocket reaches full speed, and the power is cut off, it is moving forward at approximately the same velocity, and the efficiency is about 7 per cent, he stated.

Mr. Nerad explained that if the fuel were cut off earlier in flight, when the rocket's own speed was but one per cent of that of the exhaust gases, the corresponding efficiency would be only a tenth of one per cent.

With atomic fuel, he said, an exhaust velocity of 100,000 meters (about 62 miles) per second might be possible. For the same rocket speed as the V-2, this would give an efficiency of about an eighth of one per cent, and the cost of fuel might be about $28,000. If the exhaust velocity were half the speed of light (about 93,000 miles per second) the efficiency would be a thousandth of a per cent, and the fuel cost about $42,000,000. With rocket speed of 50 miles a second, at this exhaust velocity, the efficiency would be a sixteenth of one per cent. However, to attain this rocket speed far more fuel would be needed, making its total cost over two billion dollars for a single rocket.

From economic considerations, chemical propellants for rockets are likely to be advantageous, even in the long-range field, Mr. Nerad said. When atomic fuels arrive, he continued, they must be linked with a propellant of moderate velocity. As such a propellant, which is the material actually discharged from the rocket's exhaust nozzles, hydrogen gas seems to offer important theoretical advantages, he stated.

The G-E scientists called attention to the metallic hydrides, which are compounds of metallic elements with hydrogen. In these compounds, hydrogen is stored in chemical combination, and they might be a possible source of hydrogen for rocket propulsion, in combination with other means.

It is therefore likely that hydrogen will be the key to the far future, he concluded. Should development in chemical propellants advance the technology in this direction, it is possible that the day of the interplanetary rocket will arrive sooner. The very important problems of safe handling, storage, and use of these propellants means that great effort over a long period of time may be foreseen. The military and civil rockets of the present day, and the normal extension of this terrestrial field, leaves room for much research and development in the field of chemical propellants.

NBS Automatic Computer

SINCE its dedication in June, 1950, the National Bureau of Standards Eastern Automatic Computer (MECHANICAL ENGINEERING, September, 1950, page 738) has solved a large number of important problems and has demonstrated a remarkable reliability in operation. Until now, little or no reliability information has been available on any postwar high-speed electronic computer in regular use. The Seac reliability data are based on actual operation over a period of three months, October through December, 1950.

Seac's operations were scheduled on a 24-hr per day, 7 days per week basis during this period. In general, of each week's 168 hr, 16 were reserved for preventive maintenance, while 76 hr were allocated to engineering development and testing of new computer equipment. The remaining 76 hr were devoted to Seac's primary mission, the solution of problems.

For the entire three months, 76 per cent of the total time assigned to problem solution was "good" time. Week by week during the period the reliability trend was irregularly upward, with the figure reaching a high of 96 per cent for the last week.

The good portion of the time dedicated to problem solution was that in which (1) either problem solutions or coding checks were turned out correctly by the machine, or (2) the machine was in good operating condition but idle. The machine was actually solving problems correctly during more than half (52 per cent) of the time assigned to problem solution; coding checks took 17 per cent of the time; and during only about 3 per cent of assigned time was the machine in order but idle.

Down time—28 per cent of the total hours allotted to problem solution—was a combination of (1) time lost because of machine misfunction during problem solution (including the time used for rerunning problems), (2) time lost while machine difficulties were being diagnosed and remedied, and (3) time during which the machine was out of order and idle.

Good time was a similarly high proportion—76 per cent—of the total time assigned to engineering work during the three-month period. Good time, in this case, was that in which there was no difficulty with any machine unit which had previously been put into regular operation.

Seac was producing correct solutions during some 516 hr in the last three months of 1950. Since the machine can add or subtract pairs of 14-digit numbers up to 5000 times per sec, and multiply or divide them 330 times per sec, an enormous number of individual mathematical operations are performed in each functioning hour. The great speed of the giant computer makes feasible the solution of lengthy problems which it would be quite impracticable to attempt by less advanced methods. Because of its speed, such a computer, even if down

a considerable percentage of the time, may have a much higher output of useful results than the best prewar mechanical computer working full time.

In the interest of both economy and reliability, Seac uses far fewer vacuum tubes than did the first computers of this type built during World War II. Eniac—the pioneer in this field—contained 18,000 vacuum tubes. Seac, on the other hand, has only 800 tubes. This does not mean, however, that computing capacity has been sacrificed, or that Seac is intrinsically a simpler machine. In Seac, vacuum tubes are used only for amplification; 11,000 germanium diodes are used in preference to tubes for computing and switching functions. Germanium diodes are longer-lived and, since they have no filaments or heaters, reduce the amount of wiring and eliminate a major source of heat.

Seac has disposed of a wide range of important problems since its unveiling. Air Force problems of a production-scheduling nature have received the greater part of the computer's attention. These problems have been reduced to the solution of large systems of linear algebraic equations. Other tasks attacked by Seac concerned such varied matters as electronic-circuit design, optical-lens calculations, relative abundance of chemical elements, complex mathematical functions, and sorting and tabulating studies for the Social Security Administration and the Bureau of the Census.

Coal to Oil

COMPLETION of a two-month experimental run in which more than 50 railroad carloads of coal were converted to synthetic oil at the Coal-Hydrogenation Demonstration Plant of the Bureau of Mines, at Louisiana, Mo., was announced recently.

Characterizing the operation as "highly successful," the Bureau plant officials reported that the entire shipment of 2600 tons of coal, from the Kentucky No. 11 seam, yielded nearly 8000 bbl of synthetic oil, or 3.7 bbl of oil for each ton of moisture-free coal processed. The synthetic oil produced in this plant run will now be converted to high-octane gasoline in vapor-phase operations. Thousands of gallons of such synthetic gasoline previously produced by the Louisiana, Mo., plant have been undergoing extensive tests by the armed forces.

The test with Kentucky coal was the sixth major run involving simultaneous operation of all primary coal liquefaction phases of the plant, it was stated. Up to 75 tons of coal daily was processed during this two-month run which continued uninterrupted on a round-the-clock schedule, seven days a week. Raw material was supplied without cost to the Government through a co-operative agreement between the Bureau of Mines and the Kentucky Coal Agency, Inc., of Madisonville.

Numerous mechanical improvements and other refinements now incorporated in the demonstration plant contributed to favorable test results, and a number of new and special operating techniques developed by the Bureau during previous plant runs permitted more efficient plant control, the Bureau of Mines reported.

Among processing features considered of significant value in conserving strategic materials for defense use was the substitution of a highly efficient and cheap iron catalyst for scarce tin catalyst, formerly used in coal hydrogenation. The readily available iron-catalyst also makes unnecessary the use of other catalysts containing such strategic materials as cobalt, nickel, chromium, or molybdenum. Mechanical improvements tested during the run included a change to welded hot pipe construction in the converter stalls, reduction in converter volume, the use of a new-type spring-loaded and lubricated injection-pump packing, and the use of new valve material more resistant to erosion.

Although complete operating data have not been compiled, Bureau reports stated that the Kentucky coal showed a high degree of liquefaction at a conversion pressure of 7700 psi and at a temperature of 8750 F with a hydrogen partial pressure of 6100 psi.

In addition to the added technology and processing data derived, Bureau officials pointed out that the latest experimental run at the demonstration plant marks a further step in proving the engineering feasibility of operating American-built plants of this nature.

High-Speed Torpedo

A DEADLY new high-speed torpedo which will automatically "home" on an enemy submarine, on the surface of the sea or at any depth to which it can submerge, has been perfected by the Navy and will soon be in quantity production, according to the CADO *Technical Data Digest*, June, 1951. The new weapon, the Navy says, "will present a positive threat to any submarine now in existence or being built."

Chief of the Navy Bureau of Ordnance, Rear Admiral M. F. Schoeffel, declared that the torpedo could best be described as a "Sunday punch" weapon which would probably be reserved for use until an enemy undersea boat had been definitely located and identified.

He added that the torpedo could be fired from surface ships, subs, or aircraft, and predicted that its development would result in the Navy's return to widespread installation of torpedo tubes on all its ships except cruisers and other large craft.

It was explained that the new weapon operates on the same principle of sonic homing on the noise made by an enemy submarine that was employed successfully, but only to a limited extent, during World War II. The torpedo is said to be at least twice as fast as those developed and used during the last war and can easily be equipped to home on a completely silent sub trying to wait out the threat of attack by fitting it with a radar mechanism which would pick up reflections of sounds sent out by the torpedo itself which are then reflected back by the hull of the submersible.

Admiral Schoeffel said that the new torpedo is propelled by a chemical fuel in which combustion starts when the weapon is submerged in sea water. This principle was first employed during the latter phases of the last war. The Admiral also declared that it is not only a great deal faster than earlier-type torpedoes but leaves less wake and would therefore be harder to detect and avoid. The weapon, he said, will be equally effective against surface craft and subs.

Special Lubricants Tests

STATIC friction tests of a number of relatively new special lubricants, in combination with various metals, have recently been completed at the National Bureau of Standards. Selection of a lubricant for a particular special application was the immediate goal of the investigations, which were sponsored by the Naval Ordnance Laboratory and conducted by H. S. White of the NBS engines and lubrication section. Although lubricant information was the primary concern of the tests, the effect of metal composition and of metal surface finish on static friction was also investigated.

Static friction coefficients are indexes of the ease with which one of a pair of metal surfaces (lubricated, in the present case) will start to slide in relation to the opposing surface. While

TABLE 1 LUBRICANTS USED IN STATIC FRICTION TESTS

Code no.	Lubricant
7	Navy symbol 2110 oil (SAE 10)
13	Chlorinated hydrocarbon
14	Organic phosphate ester
15	Fluorinated hydrocarbon S (medium viscosity)
16	Fluorinated hydrocarbon S + 1 per cent oxidized petroleum compound
17	Fluorinated hydrocarbon S + 1 per cent molybdenum disulphide
18	Fluorinated hydrocarbon FS (light viscosity)
19	Fluorinated hydrocarbon S + 1 per cent graphite
20	Perfluorokerosene
21	Fluorinated hydrocarbon FS + 0.5 per cent copper phthalocyanine
22	Silicone DC-200 (100 centistokes at 25 C)
23	Fluorinated hydrocarbon FS + 2 per cent silicone grease DC-44 (medium)
24	Fluorinated hydrocarbon KEL-F
25	Fluorinated hydrocarbon FS + 5 per cent fluorinated grease (light)
26	Grease G (23.5 per cent sodium soap)
27	Grease G + 5 per cent molybdenum disulphide
28	Molybdenum disulphide (dry)
29	2110 oil + 1 per cent molybdenum disulphide
30	Fluorinated hydrocarbon FS + 1 per cent zinc oxide
31	Fluorinated hydrocarbon S + 2 per cent molybdenum disulphide concentrate
32	Fluorinated hydrocarbon S + 0.75 per cent boron nitride (amorphous)

low static friction is desirable in many applications, it cannot be taken as an indication of over-all lubricant merit.

Some 20 special lubricants, principally chlorinated and fluorinated hydrocarbons with and without various additives, were tested, Table 1. Additives investigated included graphite, molybdenum disulphide, zinc oxide, boron nitride, and an oxidized petroleum compound. An SAE 10 mineral lubricating

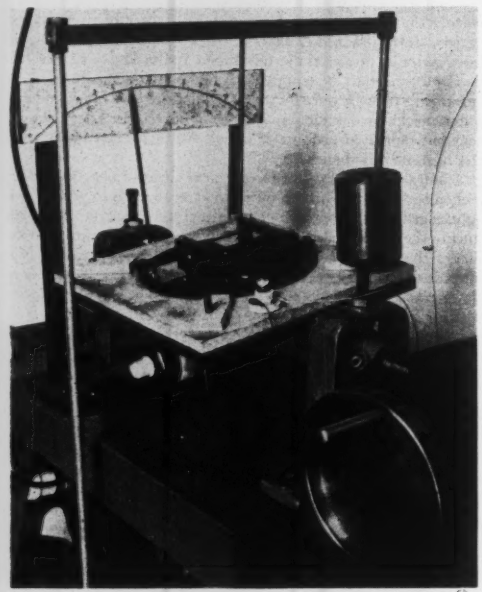


FIG. 6 INCLINED-PLANE APPARATUS USED BY THE NATIONAL BUREAU OF STANDARDS IN MAKING RECENT STATIC FRICTION TESTS WITH SPECIAL LUBRICANTS

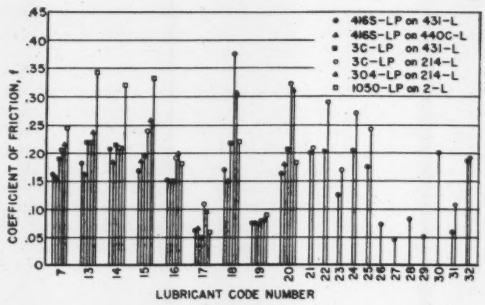


FIG. 7 GRAPHIC SUMMARY OF STATIC FRICTION TESTS MADE AT THE NATIONAL BUREAU OF STANDARDS

oil (Navy symbol 2110) was used as a reference or basis of comparison. Metal surfaces used in various combinations for the tests were stainless steel, carbon steel, cast iron, aluminum alloy, and chromium plate. An inclined-plane test apparatus of conventional design was used.

In the test method employed, a metal rider rests on a larger flat lubricant-coated metal plate. See Fig. 6. In the Bureau tests a load of 40 psi was used, and a temperature of 100 F was maintained. The plate, initially horizontal, is slowly tilted until the rider starts to slide. The sliding of the rider is indicated electrically; a small motion of the rider closes a low-voltage circuit and lights a lamp. The tangent of the angle of tilt at which sliding begins is the coefficient of friction. This follows from the definition of the coefficient of friction, f, which is defined as F/W, where F is the tangential force required to initiate sliding and W is the force normal to the surface.

Lowest static friction was shown, in general, by test lubricants containing molybdenum disulphide—closely followed by a mineral lubricating grease, dry molybdenum disulphide, and a fluorinated hydrocarbon with graphite additive. Lubricants for which the most favorable data were obtained showed static friction about 50 to 60 per cent less than the SAE 10 reference oil. A lubricant containing an oxidized petroleum compound, and one containing a silicone grease, gave slightly less friction than the SAE 10 oil. Higher friction than the reference oil was shown by the chlorinated and fluorinated lubricants without additives, and by the remaining special lubricants.

Some of the metal combinations used ranked about the same in friction, relative to other metal combinations, regardless of the lubricant with which they were tested. In the case of certain metal combinations, on the other hand, the relative rank of the combination depended to a much greater extent on the lubricant used.

Certain heat-treated stainless-steel combinations showed, with most lubricants, the lowest friction values. With a few lubricants, a chromium-plated rider on a heat-treated stainless-steel plate gave low friction values comparable to those for the stainless-steel combinations. Dependence of relative friction rank on the lubricant used was especially great in the case of an Alcoa 214 plate used with either a chromium-plated rider or a stainless-steel rider, and also for the combination of a 1050 steel rider and a cast-iron plate; each of these combinations ranked high in friction when used with one or more lubricants, but low when tested with other lubricants.

Polished surfaces sliding on lapped surfaces tended to give lower friction and less variation than ground surfaces sliding

on ground surfaces. Lapped plates and lapped and polished riders were used in most of the tests. Lapped and polished surfaces are more easily reproduced, and are more commonly used for machine parts involving small clearances.

For each metal rider-and-plate combination, tests were run alternately with the reference oil and with a number of the special lubricants. First, a series of observations was made using the reference oil. This was followed by a set of observations with one of the special lubricants. Then a second run with the reference oil was made, followed by another of the special lubricants, and so forth. After each set of observations with a particular lubricant the plate and rider were carefully scrubbed and rinsed, using absorbent cotton and a number of solvents. This was done to insure that residual contamination from one lubricant should not affect results obtained with subsequent lubricants. The repeated sets of observation with the reference oil served by their consistency to confirm the reliability of the special lubricant data; this use of the reference oil showed both that the cleaning process was adequate and that test conditions had not been accidentally altered.

Chain Drive

A NEW power-transmission chain drive, said to provide for the first time, a power-transmitting medium that combines the ruggedness and dependability of a gear drive with the smoothness and lack of vibration of a belt, has been announced by the Morse Chain Company of Detroit, Mich.

Called the Morse Hy-Vo, the drive makes possible single-

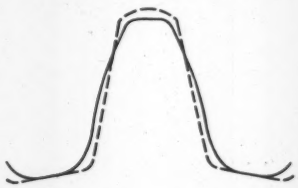


FIG 8 SPROCKETS FOR THE NEW POWER-TRANSMISSION CHAIN DRIVE HAVE TEETH OF INVOLUTE DESIGN

(Solid line shows contour of a Hy-Vo sprocket tooth, while the superimposed broken line indicates the outline of a standard silent chain sprocket tooth. The involute design makes for smoother engagement of the chain and sprocket, and contributes to vibrationless action of new drive.)

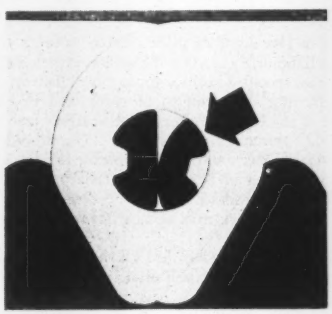


FIG. 9 NEW COMPENSATING ROCKER JOINT ON CHAIN DRIVE HAS HIGHLY REFINED DESIGN FEATURES FOR REDUCING WEAR IN THE JOINTS

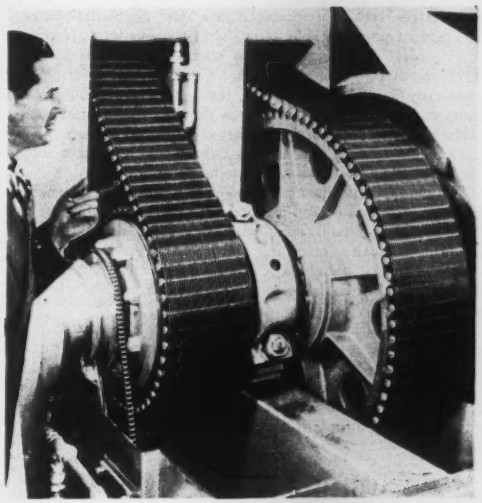


FIG. 10 THESE TWO 2-IN-PITCH, 12-IN WIDE HY-VO DRIVES TRANSMIT THE TERRIFIC POWER NEEDED BY THIS NEW DIESEL-ELECTRIC DRAWWORKS DESIGNED TO DRILL 20,000-FT HOLES

(The 1500-hp, 500-rpm drawworks was built for Standard Oil of California by Emsco Derrick and Equipment Company. The new chain drives made possible for the first time construction of a portable Diesel-electric drilling unit of this size.)

drive units capable of transmitting as much as 5000 hp, at linear speeds up to 6500 fpm or rotative speeds up to 3600 rpm. A Hy-Vo drive only two inches wide has transmitted as much as 500 hp, according to the company.

Morse officials state, however, that the current critical shortages of necessary materials have made it necessary to restrict orders for the new drive only to those with defense or essential ratings.

Company engineers report that the new drive gives industrial users, and engine and motor designers, a power-transmission drive that will allow them to develop and use much smaller and more inexpensive power plants. Such plants previously had been ruled out because compact, low-cost, power-transmission equipment was not available to handle the speeds required to produce high horsepower in small engines.

Besides tremendous increases in speeds with much narrower widths than conventional drives, Hy-Vo drives are said to eliminate the need for wide, unwieldly units with costly shaft extensions, outboard bearings, mounts, and other accessories presently required for high-speed engines.

According to Morse engineers, this power drive can increase efficiency and reduce power-transmission costs in any field where single motors or engines are used in sizes of approximately 100 hp and up.

Potential fields of use include commercial fishing, lumbering, petroleum, irrigation, mining, chemicals, papermaking, quarry operations, cement and asphalt manufacturing, and steel manufacturing—in fact, any field where a heavy-duty high-speed drive is required.

It is also ideally suited for power transmission on heavier types of self-propelled mechanical-handling equipment, for large fans and heavy-duty ventilating equipment, and for use in public-utility installations.

Secret of Hy-Vo performance is a new chain-and-sprocket engagement principle that virtually eliminates what is known as "chordal" or polygon action common to the usual chain drive—a bumping, slapping, jerking action, and vibration that eventually fatigues the chain, leads to drive failures, and shortens chain life. It also limits the chain's performance.

Hy-Vo sprockets also are entirely new in design. They resemble involute gears, having curved involute teeth which engage the Hy-Vo links with conjugate action.

The chain drive incorporates a new compensating rocking joint with special design features for eliminating slippage and wear. During chain articulation, the joint shifts the pitch line automatically, engaging the involute sprocket teeth in such a way that the chain follows a path truly tangent to the sprocket pitch line. The result is a smooth, almost vibrationless action.

Pitch elongation or "stretch" has been eliminated in the drive to the extent where it is virtually unnecessary to provide any means of take-up. Thus, Morse engineers point out, Hy-Vo is ideal for use on drive applications such as engine compounding or heavy-duty power transfers where center adjustment is impractical.

Atomic Energy Control

IF men are smart enough to find a means for preventing all war, then international as well as national control of atomic energy may become unnecessary, Harry A. Winne, Mem. ASME, vice-president in charge of engineering policy of the General Electric Company, said recently in Boston, Mass., at a meeting of the American Society for Metals.

Mr. Winne, who was a member of the committee which formulated the original American plan for atomic-energy control, proposed in the United Nations, predicted that at some time in the future the government will have the opportunity to discontinue its major operations in this field and to permit private industry to forge ahead.

However, he added, I cannot forecast whether or not our government will wish to take advantage of this opportunity.

Under present conditions, with practically all the country's production of atomic fuel going into bombs, and with such emphasis on secrecy, it is obvious that the government will retain complete control of all the atomic reactors where such fuel is made, the G-E official said. Even so, he pointed out, it could sell to utility companies any electricity generated in the process, or even steam, or heat in some other form.

He expressed the hope that the present situation will not continue for very many years. There should be a limit, he said, to the useful size of a bomb stock pile. Our potential enemies will, in time, probably know as much about atomic energy as we do—possibly more. So the need for extreme secrecy may disappear. If and when atomic bombs become as common and as widely spread as TNT and other munitions, I see little chance for effective international control, he said.

We must find means for preventing war entirely, he declared, and then such control may not be required.

Although work being carried on for the Atomic Energy Commission by General Electric and other groups will eventually lead to practicable atomic power, he said, it will be a long time —twenty years or more perhaps—before atomic energy can have any appreciable effect on our electric power industry. However, he added, experimental power-producing reactors probably will be operating within three to five years.

Mr. Winne warned that mere expenditure of large sums of money cannot greatly reduce the time cycle for economic development of an atomic-power industry. He compared it with the gas turbine, first proposed many years ago, and now becoming an important source of power for aircraft, locomotives, and other applications.

Even if billions of dollars had been expended in gas-turbine development about 1900, it would probably not have become economically feasible much sooner, he said.

While useful atomic power is under development, he pointed out, radioactive materials produced in atomic reactors are finding many important applications. They are used to cure disease, they aid biologists to study living processes, and they are giving metallurgists a new insight into the behavior of metals, Mr. Winne said.

He described how G-E scientists are using them to study "self-diffusion" of atoms from one piece of silver to another in close contact. In one there are silver atoms made radioactive by exposure in the atomic reactor at Oak Ridge, Tenn. These behave like ordinary silver atoms, but when they are found in the other piece they may be identified. In this way, he said, it has been found that the atoms move about a million times as easily along the boundaries of the crystal grains as elsewhere.

Mr. Winne said that scientists hope, by such methods, to find out more about the exact way in which metals slowly change form under high temperatures, and perhaps to develop new alloys which show less of such "creep."

He told how radioisotopes have been used to solve a problem in the manufacture of electric relays, concerning the transfer of metal from one contact to another. Formerly, testing a relay required that it be operated as many as 100,000 times, in order to get an appreciable transfer of silver. Now, he said, radioactive silver is used in one of the contacts and measurable results are obtained after it is closed only ten times.

Fixed-Frequency Cyclotron

THE largest fixed-frequency proton cyclotron in the world is now in operation at the Oak Ridge National Laboratory. The 86-in. machine was first successfully operated on Nov. 11, 1950, and shortly afterward was operated at over 20 Mev. Utilization of equipment already available in the Electromagnetic Plant made it possible to have the cyclotron ready for test operation within a year from the time ground was broken.

The new "atom smasher" is an important addition to the research facilities of ORNL. With the cyclotron it will be possible to produce radioisotopes not obtainable from the pile and to extend studies of the effects of radiation. There are many nuclear reactions that cannot be obtained by the action of neutrons in the uranium pile. Stable isotopes being produced at the Laboratory can now be used as targets in the cyclotron to produce specified radioisotopes more efficiently.

This is the first cyclotron to be completed in the southeastern part of the United States. The nearest machines are at St. Louis, Mo., and at Columbus, Ohio. The Brookhaven National Laboratory has a 60-in. cyclotron for the acceleration of deuterons, the nuclei of heavy-hydrogen atoms, to about 20 Mev. Argonne National Laboratory is constructing a similar machine. A 42-in. cyclotron at Los Alamos accelerates deuterons to 11 Mev.

Cyclotrons are usually identified by the diameter of the pole pieces of the large magnets required. The pole pieces of the new ORNL magnet are 86-in. across.

This is the first time a fixed-frequency proton cyclotron has been operated above 12 Mev. Both the University of Pittsburgh and the University of Rochester have similar cyclotrons operating at somewhat less than 10 Mev. The acceleration of

protons to 20 Mev is comparable to accelerating deuterons to 40 Mev.

High energy is attained in the ORNL 86-in. cyclotron by using very high voltage in the radio-frequency system which drives the protons. The high voltage, over one-quarter million volts, makes it possible to obtain 20 Mev with the protons making only about 40 turns. Losses resulting from relativistic change in mass of the protons are diminished since there is less opportunity for the protons to get out of synchronization with the pulses which drive them. The use of such high voltage in cyclotrons is very unusual.

The vertical design of the 86-in. cyclotron is unique. The dee system within the vacuum tank is suspended from above and is inserted through the top of the tank. A traveling crane is used for lifting the dee system out of the vacuum tank and transporting it to servicing and reassembly areas. This also simplifies the problem of handling radioactive equipment.

As a proton moves in a circular path in the magnetic field of the cyclotron it receives two pushes from the high-voltage system for every turn. Gaining velocity with each push, the proton spirals outward from the center. In a 40-turn spiral the proton would receive 80 pushes. When a quarter million volts are being supplied by the 86-in. cyclotron, a proton may gain 20 Mev. The proton then has a velocity of over 30,000 mps.

As the protons spiral outward from the center of the cyclotron, gaining velocity at every turn, they increase in weight and consequently their gains in velocity become less. This increase in weight with velocity is an important factor in the designing of cyclotrons. As the particles become heavier at higher speed, they are accelerated less at each turn and thus tend to get out of synchronization with the applied power. For very high energies the synchrocyclotron is designed so that the frequency of the accelerating pulses is modulated or varied in such a way as to compensate for this increase in weight. Such a machine is, however, somewhat less efficient due to the smaller and less frequent pulses of particles produced.

The 86-in. cyclotron is a rather large gun for such small bullets. Protons are so light that about 3×10^{26} protons would weigh only a pound. They are so small that "laid end to end" 10 million million would reach perhaps an inch.

Jet Airliner Fleet

THE world's first fleet of jet airliners will go into regular service on the London-Rome-Cairo route this winter, according to the British Information Services. Despite the rearmament program, British Overseas Airways Corporation will switch from orthodox piston-engined types to 490-mph De Havilland Comet jets, of which 14 have already been ordered.

Although final decisions have not yet been made, it is expected that Comet airliners will later be used on flights to Southern Africa, Pakistan, India, and Australia. Consideration is also being given to the operation of these planes on the New York-Bermuda-Nassau triangle and a long-range version of the Comet will in due course fly on the London-New York Atlantic run via Prestwick and Gander.

The medium-range version is designed mainly for stage lengths of between 1000 and 2000 miles. A prototype recently flew the 2200-mile nonstop route from London to Cairo in just over $5\frac{1}{2}$ hr, half the time taken by piston-type airliners.

In addition to BOAC, which is reported to have placed further orders for the Comet, three overseas airlines have made contracts with the De Havilland Company. A 48-seater version of the Comet is likely to go into service with Canadian Pacific Airliners; Panair to Brazil, a subsidiary of Pan American Airways, have booked three Comet machines; and a French company, Chargeurs Reunis, are reported to have placed orders for the Aeromaritime Transport Union, which runs airline services from Paris to Dakar and other African stops.

Multifuel Burners

(*Continued from page 638*)

of these general types each with recommending features for certain fuels and furnace shapes. Specific designs are available for special services. As an example, one type frequently seen on larger installations is the Combustion Engineering tangential tilting multifuel burner. The same general design as that of the intertube burner is used, except that in addition the entire burner unit can be tilted or adjusted in a vertical plane to change the angle of firing. These burners are usually mounted on the corners of the furnace, firing tangentially to a small circle in the center of the combustion chamber. This arrangement produces intimate mixing and intense turbulence with corresponding high rates of heat release. This provides for an additional control of the steam superheat temperature. The preceding discussions have been concerned primarily with design in relation to pulverized-fuel firing; however, a burner designed in this respect will be capable of complete and uniform combustion of other fuel types—liquid and gaseous.

Another phase of the use of multifuel installations is that of multiple-fuel firing in stoker-type furnaces. Space, however, does not permit a discussion of this phase.

CONCLUSIONS

It is recognized that due to conditions existing at the time of design and installation it may not be feasible to provide for complete fuel flexibility. Nevertheless, the design of the furnace and attendant equipment should be such that alternative fuels may be conveniently handled at some future date, if desired. In this connection the furnaces should be designed for the fuels requiring the largest combustion volume. Thus those furnaces designed for pulverized coal will be suitable for either liquid or gaseous fuels. Burners should also be designed for pulverized-fuel combustion since they will, in general, be satisfactory for oil or gas firing. It may not be advantageous to install all of the handling and preparation equipment required for pulverized-coal firing at the time of the original construction. However, with a correctly designed burner and furnace this attendant coal equipment can be installed at a later date, without furnace changes or serious operating interruptions, provided that the fuel market predicates such a conversion.

In the final analysis the installation of multifuel-burning equipment offers a practical solution to the problem of providing the maximum economy and flexibility in operation throughout the service life of a fuel-burning unit. In addition, it opens up a considerable field for the profitable utilization of a number of waste or by-product fuels. Because of the designer's inability to foretell the future with regard to either fuel costs or availability, it is imperative that operating flexibility be built into the original installation.

ACKNOWLEDGMENT

The writer gratefully acknowledges the assistance of the Babcock & Wilcox Company, Foster Wheeler Company, Peabody Engineering Company, and Combustion Engineering-Superheater Company for drawings and data on the multifuel-burner types.

ASME TECHNICAL DIGEST

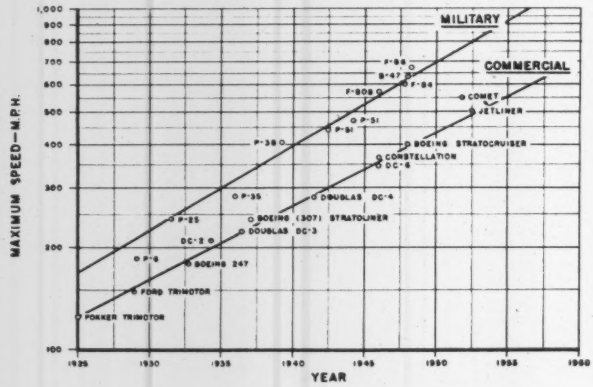
Substance in Brief of Papers Presented at ASME Meetings

Turbojet Aircraft and Engines

Turbojet Aircraft With Special Reference to the "Jetliner," by E. H. Atkin, A. V. Roe Canada Ltd., Toronto, Canada. 1951 ASME Semi-Annual Meeting paper No. **51—SA-23** (mimeographed).

THE Jetliner started out as an aircraft to fly ranges up to 500 miles with a pay load of 10,000 lb; having a gross weight of about 55,000 lb; and powered by four Rolls-Royce Derwent 5 engines. The object was to provide a cruising speed of not less than 400 mph at 30,000 ft. Furthermore, the aircraft was to operate on runways not exceeding 5000 ft in length. The plane has now developed, while retaining the same physical dimensions, into an aircraft which can be powered by one of several alternative jet engines, in addition to the Derwent 5, such as the J-33 or J-42, and with a take-off weight of the order of 70,000 lb depending upon the type of engine chosen; a landing weight of 60,000 lb, a pay load of up to 12,000 or 13,000 lb, a cruising speed of at least 450 mph, together with fuel capacity for still-air ranges over 2000 miles with a practical operational range of the order of 1000 miles. This has been achieved while retaining the desired landing and take-off characteristics which will enable the aircraft to get in and out of runways of between 5000 and 6000 ft. The stalling speed has remained comparative with those obtaining for other up-to-date postwar intercity aircraft, thus demonstrating that the jet aircraft need carry no penalty from this point of view. The additional range has permitted the aircraft to take advantage of a greater operating height under certain conditions up to 35,000 ft. The handling characteristics of the aircraft on the ground have proved to be quite normal. This is contrary to the doubts and fears of many people prior to the actual operation of a jet-transport prototype. It was originally imagined that the terrific blast of hot gases from jet engines would make the jet-transport extremely difficult to handle in the normal airport pattern from the ground personnel and passenger point of view, and it was thought that the aircraft would be difficult to maneuver. Furthermore, it was imagined that the noise from the jet engines would be highly objectionable.

The Jetliner has been taken into such airports as Chicago, New York, and Washington, and has demonstrated that the approach procedure, maneuverability, and speed range of the aircraft are perfectly normal and no different from other aircraft; that the take-off and landing runs required are equal to or better than current types, and the handling



TRENDS IN CRUISING SPEEDS OF MILITARY AND COMMERCIAL AIRCRAFT

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ability of the aircraft on the ground is little different from that of the reciprocating-engine types. Furthermore, the impact of the exhaust jets on the runway surface, passengers, and ground personnel, is not particularly detrimental. Very little discretion on the part of the pilot is required in handling the throttles when coming in close with other aircraft without discomfort outside the normal distances outside which people normally stay in the case of reciprocating-engine aircraft.

As regards noise, the general conclusion by airport authorities who have had the opportunity to study this question is that the noise from the jet aircraft is actually less objectionable and less intense in many ways than that at present emitted by reciprocating engines.

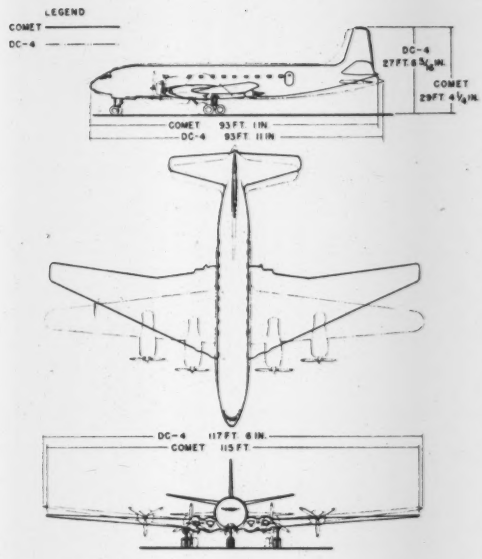
Turbojet Transports With Special Reference to the Comet, by W. G. Townley, Canadian Pacific Air Lines, Ltd., Vancouver, AMF, B.C., Canada. 1951 ASME Semi-Annual Meeting paper No. **51—SA-15** (mimeographed; to be published in condensed form in MECHANICAL ENGINEERING).

THE commercial operation of turbine-powered aircraft has aroused intense interest among the world's airline operators and within the engineering fraternity. This paper outlines in general terms some of the main operational problems which confront an airline operator on a specific route. This paper provides some of the background around which the decision to operate a turbojet transport was based.

One of the first decisions which an airline management must face in evaluating a new aircraft is—where will we use it? This decision has been made by Canadian Pacific Air Lines and it is intended to operate the Comet initially on the North Pacific route, originating in Vancouver, British Columbia, and terminating at Tokyo. Although the present route continues beyond Tokyo to Hong Kong, it will not be possible to operate the Comet beyond Tokyo until such time as certain improvements to the present restricted airport at Hong Kong are made.

The choice of a route is based mainly on two factors: (1) The need for service which exists as a result of traffic commitments, and therefore the amount of revenue which is available to the carrier, and (2) the operational characteristics of the route which, of course, to a large extent determine the type of equipment which can be operated over the route.

From an economic point of view, it is necessary to apply the Comet to routes where the various terminals to be served fall within the classification of a long-range operation. This economic requirement is based on the fact that the optimum cruising altitude of a turbojet-powered aircraft is so high that it becomes impractical to consider the operation of such an aircraft between any two points whose distance is separated by less than 1200 nautical miles. The Orient route was chosen operationally, bearing in mind these distance requirements, and also because of the generally lower ambient-air temperatures which apply and the adequate runway lengths and navigational facilities at the points of call. All of these factors tend to keep development problems to the minimum which is obviously most desirable during a conversion period such as takes place in the application of a new type of aircraft.



SIZE COMPARISON BETWEEN THE DE HAVILLAND COMET AND THE DOUGLAS DC-4

The Mamba Engines in the Apollo Aircraft, by B. H. Slatter, Armstrong Siddeley Motors, Ltd., Parkside, Coventry, England. 1951 ASME Semi-Annual Meeting paper No. **51—SA-14** (mimeographed; to be published in Trans. ASME).

THE design of the Mamba power plant involved a number of problems peculiar to propeller-turbine engines, notably with regard to the control of the engine and propeller. It was necessary to consider not only the normal running of the engine but the engine requirements and effects on the aircraft during handling, stopping, and restarting in flight and following various possible types of power-plant failure.

During the early flight testing of the Apollo various defects came to light in connection with such matters as nacelle ventilation, engine starting, and performance.

This paper describes the various problems connected with the Apollo engines which have been encountered and overcome either in the design stage or following experience in the aircraft.

The Mamba engine embodies a 10-stage axial compressor, six vaporizing combustion chambers, and a two-stage turbine. The compressor and turbine rotors are directly connected together and revolve at a maximum speed of 15,000 rpm.

The rotor system is coupled to the propeller through a compound epicyclic reduction gear having a ratio of 0.097:1.

The bare engine has a maximum diameter of 28 in. and weighs 750 lb. It was originally designed to provide 1000 shp and 300 lb of jet thrust at take-off.

In building this engine into a power unit for the Apollo, the main aims were to keep the frontal area of the nacelle to a minimum, group all the engine accessories on the engine unit, and, at the same time, provide good accessibility for maintenance.

The Flying Boat With Special Reference to the Princess, by H. Knowler, Saunders Roe Ltd., East Cowes, Isle of Wight, England. 1951 ASME Semi-Annual Meeting paper No. **51—SA-7** (mimeographed; to be published in condensed form in MECHANICAL ENGINEERING).

THE general design of the Princess Flying Boat is discussed. The first part of the paper is concerned with the considerations which determined the type, the size, and the choice of power plants. The second part is devoted to a discussion and description of novel engineering features which have been incorporated in this large aircraft.

The paper shows that, first, it is probable that refueling stops at other than traffic centers will eventually disappear in order to reduce the journey time between major cities and to avoid inconvenience to passengers. It is also shown that, even at this time, a journey such as that from England to New York can be scheduled for direct operation without increased operating cost, provided very large aircraft are used. Further, it is considered that the future of the big aircraft lies with the flying boat since it overcomes airport-runway difficulties and has other advantages.

It is pointed out that the big long-range flying boat need not suffer from preconceived disadvantages such as high drag and weight; on the other hand, it meets the requirements of the passenger of the future who will demand increased comfort as well as reduced journey time. The Princess, it is considered, fits well into the future picture having all the attributes which have been discussed, including speed, comfort, and independence of airfield development, as well as the capability of low operating cost. Also, because of its size it will be in a position to meet an increasing traffic potential, and obtain a fair share of the latter. The prestige associated with the big flying boat will insure high load factors in a highly competitive market.

Propeller-Turbine Aircraft With Special Reference to the Apollo, by H. R. Watson, Sir W. G. Armstrong Whitworth Aircraft Ltd., Baginton, Coventry, England. 1951 ASME Semi-Annual Meeting paper No. **51—SA-13** (mimeographed).

THIS paper compares the advantages and disadvantages of the propeller-turbine aircraft with aircraft using other types of engines. A brief description of the Apollo, including a few of its special features, is also given.

The following points are discussed and where possible comparisons are made of corresponding effects, using different types of engine: (1) Comfort; (2) performance features affecting safety, including take-off, landing, and "engine cut" performance; (3) speed; (4) range, including effect of engines on weight and drag; (5) stacking; (6) stability and control; and (7) cost.

In making these comparisons it is emphasized that some of the figures given for the Apollo are derived from tests with the earliest type of 1000-hp engine and that other estimated figures for the 1270-hp Mamba engines are closely related to these test results. If the comparison is not always favorable to the propeller-turbine, it should be noted that an attempt is being made to present the facts rather than to win a hypothetical argument. For this same reason, some of the difficulties peculiar to this type of aircraft are also discussed, particularly in the section on stability and control.

It is concluded that the propeller-turbine aircraft offers outstanding advantages in passenger comfort and, even at the present stage of development, such aircraft can compete effectively in their ratio of pay load to take-off weight for stage lengths up to 2000 statute miles.

Production Engineering

Forces in Dry Surface Grinding, by E. R. Marshall and M. C. Shaw, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Semi-Annual Meeting paper No. **51—SA-8** (in type; to be published in Trans. ASME).

A DYNAMOMETER capable of measuring the very small forces encountered in dry surface grinding has been constructed and used to establish the following points which are discussed in this and other papers in terms of the specific energy (i.e., the energy required to remove a unit volume of metal). The following observations have been verified only under relatively mild grinding conditions and may not hold for the very large depths of cut encountered in rough grinding and snagging.

1 The vertical and horizontal grinding forces are found to be proportional to the inverse wheel speed and the width of workpiece.

2 The vertical and horizontal grinding forces are proportional to the depth of cut for depths below about 0.001 in.

3 The vertical and horizontal grinding forces increase with increased table speed.

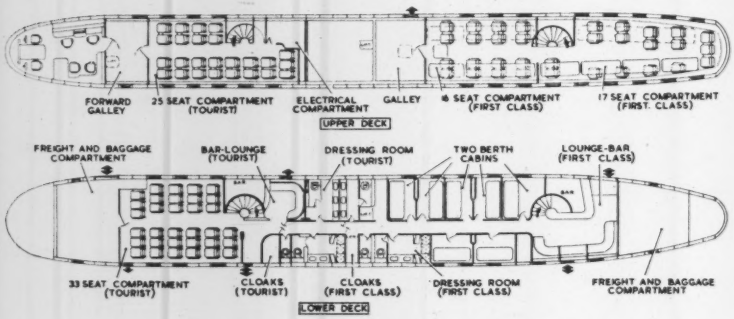
4 The specific grinding energy for a given wheel and a fixed table speed is independent of wheel speed, width of specimen, and depth of cut for depths of cut below about 0.001 in.

5 The grinding forces and specific energy are independent of the hardness of the workpiece.

6 A grinding coefficient which in formulation resembles the coefficient of friction may be defined as the ratio of the horizontal force to vertical force. It appears that when a grinding wheel is cutting freely the grinding coefficient is greater than the corresponding coefficient of friction.

7 The dressing techniques employed showed that the diamond pyramid was superior to the conventional diamond as follows: (*a*) Lower grinding force components resulted; (*b*) more consistent values were obtained; (*c*) grinding burn occurred less easily.

8 The depth of the cold-



INTERIOR LAYOUT OF THE PRINCESS FLYING BOAT

worked layer in a ground surface is approximately half the depth of cut.

9 The extent of the residual tensile stress which results from grinding extends undiminished far below the cold-worked layer and hence the cause of the stress is not due to the cold-worked layer.

The Size Effect in Metal Cutting, by W. R. Backer, Linde Air Products Division, Union Carbide & Carbon Corporation, Tonawanda, N. Y., E. R. Marshall, and M. C. Shaw, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1951 Semi-Annual Meeting paper No. **51—SA-9** (in type; to be published in Trans. ASME).

IN paper No. 51—SA-8, it was emphasized that the grinding operation differs from other single-point cutting operations in the following respects: (1) High cutting speed (about 6000 sfpm); (2) small depth of cut (0.0001 in. or less); and (3) small lateral extent of an individual chip.

The energy required to remove a cubic inch of metal (specific energy) by grinding was found to be unusually high. In this paper the significance of item 2, the size effect, is considered.

A cutting process involving the formation of very small chips at high cutting speeds (micromilling) is investigated, and the results are applied to a study of the grinding operation. The shear energy involved in grinding is compared with that in turning, micromilling, and the tensile test, and a significant increase in shear energy is observed with decrease in specimen (chip) size. The shear stress involved in grinding metal under mild conditions is found to correspond to the theoretical strength which is about 1.8×10^6 psi for steel. The grit depth of cut is shown to be a more important variable in the interpretation of grinding data than the more conventional wheel depth of cut.

Surface Temperatures in Grinding, by J. O. Outwater, E. I. du Pont de Nemours and Company, Wilmington, Del., and M. C. Shaw, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1951 ASME Semi-Annual Meeting paper No. **51—SA-10** (in type; to be published in Trans. ASME).

IN paper Nos. 51—SA-8 and 51—SA-9 in this series on the fundamental aspects of the grinding process, the results of data obtained from a grinding dynamometer were presented and discussed. The energy per unit volume was found to be unusually high in grinding as a result of the relatively small depth of cut associated with this process. At the same time the grinding operation is normally carried out at a high cutting speed. From this combination of high cutting speed and a relatively large dissipation of energy per unit volume of metal removed (specific energy), high instantaneous values of surface temperature are to be expected. In this paper heat-transfer theory involving a moving heat source is applied to the grinding process to obtain an equation for the mean surface temperature in grinding. This equation predicts surface temperatures as high as 3000 F for a representative fine grinding operation. The analysis shows that in finish-grinding the surface temperature is reduced by decreasing the chip depth of cut but in snagging operations the surface temperature may be reduced by increasing the chip depth of cut. Representative values of the mean temperature between the chip and the grinding wheel obtained by the toolwork thermocouple technique are presented and discussed. The role of the grinding atmosphere in the production of sparks and in determining the energy involved in grinding is illustrated by experimental data. When the oxygen concentration of the atmosphere is very low, the specific grinding energy is found to be unusually high. The existence of high surface temperatures in fine grinding operations is demonstrated by the presence of a transformed surface layer that is largely retained austenite.

Petroleum Mechanical Engineering

Piping Flexibility Analysis by Model Test, by Lale C. Andrews, The M. W. Kellogg Company, New York, N. Y. 1951 ASME Semi-Annual Meeting paper No. **51—SA-24** (in type; to be published in Trans. ASME).

DURING the past 10 years, model-test flexibility analyses of piping systems have been made, under the author's direction, for nearly a hundred oil, power, and chemical companies, and for two navies. Herein are described briefly the scope of the work, the apparatus and methods employed, and a few observations on design.

The model-test method of piping flexibility analysis offers one particular advantage over all present methods of calculation of complex systems. The time required for a mathematical analysis increases divergently with the complexity of the problem; whereas that for a model test increases convergently, so to speak, for the time required per point of restraint becomes less as their number increases.

It offers a method of analyzing a very intricate system as a unit, avoiding the hazards of overdesign and underdesign that arise from the practice of breaking down a complex problem into simpler ones that are within the scope of the mathematical methods. It is the simplest available method for obtaining the loads on intermediate restraints; and is particularly useful where many solutions are needed for a single layout with different temperature conditions. Deflections obtained from model tests have been corroborated by field measurements.

Tests were recently run for six 125,000-kw units for operation at 1000 F and 1450 psi, where much of the piping was forged and bored of $2\frac{1}{4}$ Cr 1 Mo. The engineer in charge estimated that model tests of the complete systems, by showing that the maximum stresses were 300 psi under those permissible, eliminated the necessity for expansion loops of this expensive piping at a saving of $108,000.

Stress Conditions in Flanged Joints for Low-Pressure Service, by E. O. Waters, Mem. ASME, Yale University, New Haven, Conn., and Frank S. G. Williams, Mem. ASME, Taylor Forge & Pipe Works, New York, N. Y. 1951 ASME Semi-Annual Meeting paper No. **51—SA-4** (mimeographed; to be published in Trans. ASME).

THE test program reported in this paper was undertaken by the Taylor Forge and Pipe Works to establish the critical levels of strain, stress, and deflection that exist in flanged joints having dimensions typical of those used with steel pipe lines in potable water-supply systems. Such water systems generally operate at low or moderate pressure levels. The investigation was limited to flanges of the low hub and plain ring types attached to the pipe by fillet welds.

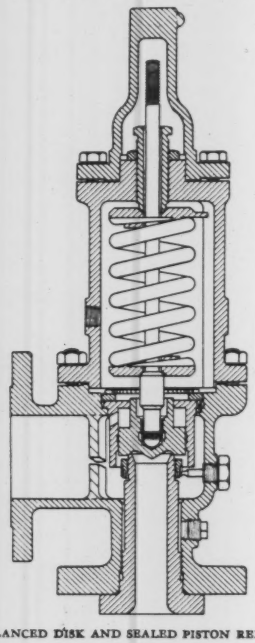
The design of flanged joints and connections for high-pressure and high-temperature connections has been well explored and reduced to standard procedures. Conditions that exist in water-supply service are generally more favorable than those encountered in similar industrial piping or in pressure-vessel service.

Thirteen test runs were made, divided into four groups. Stresses and bolt loadings were measured, using electric-resistance strain gages (SR4). A testing machine was used in one group of tests to provide simulated bolt loadings with a higher degree of accuracy than is possible with actual bolts.

Theoretical and test stresses are compared. In general, theoretical and test values agree very well, this agreement improving as water pressures increase. Important "primary" stresses remained within safe limits. Hubbed and ring flanges gave different stress distributions with lower peak values for hubbed flanges.

Some Aspects of the Design and Economic Problems Involved in the Safe Disposal of Inflammable Vapors From Safety-Relief Valves, by S. Chesler and B. W. Jesser, Mem. ASME, The M. W. Kellogg Company, New York, N. Y. 1951 ASME Semi-Annual Meeting paper No. **51—SA-18** (mimeographed; to be published in Trans. ASME).

DURING the design of nearly all petroleum refineries and similar types of units, the question always arises as to the method of disposal of the inflammable vapors released from safety relief valves. There is the first decision of whether the discharge shall vent directly to the atmosphere or to a closed system terminating in a refinery flare or a water-quenched stack. If the decision is in favor of the open system, a minimum of additional work is required. However, if a closed system is selected, a considerable number of problems must be solved in order to attain a safe and satisfactory system. In most cases this is a rather expensive system with long large lines meandering all over the refinery. The present paper does not attempt to cover the complete detailed design of such systems since the API is now in the process of preparing an extensive bulletin on the subject of "Pressure Relieving Systems."



BALANCED DISK AND SEALED PISTON RELIEF VALVE

This paper, however, presents three approaches presently being employed in the design of pressure-relieving systems in an effort to reduce their costs without sacrificing safety.

The first method assists in making the decision of open system versus closed system. It involves the use of diffusion equations in order to determine the maximum concentration of a gas that might be expected at grade when a given quantity of gas is discharged from a safety relief valve into the atmosphere. The location of this point of maximum concentration may also be determined.

The second method presents a procedure whereby, if a closed system is used, the sizes of the discharge piping may be reduced by setting the pop pressure of the conventional safety relief valve below the design pressure of the vessel.

The third method also applies to closed systems. It involves the application of a special type of safety relief valve presently being developed in order to eliminate or reduce the effects of back pressure and thus reduce line sizes in the discharge system. Experimental valve-capacity data observed by the authors is included.

In order to give a realistic picture of the cost and economy involved, typical safety-relief-valve discharge systems have been set up, sized, and priced for the various alternatives presented. Also included are cases covering the alternate back pressures permitted by the 1943 API-ASME code (10 per cent) and the 1950 ASME-UPV code (25 per cent).

Lubrication

Catalytic Effect of Several Metals on the Oxidation of Lubricating Oils, by D. W. Sawyer, Aluminum Company of America, New Kensington, Pa. 1951 ASME Semi-Annual Meeting paper No. **51—SA-3** (in type; to be published in Trans. ASME).

BASED on tests made with eight types of oils, it has been shown that aluminum-base alloys and stainless steel have very little or no catalytic effect on the oxidation of lubricating oils and are more resistant to corrosion by these oxidized oils than many of the other commercial metals tested. Copper and low-carbon steel were found to accelerate oxidation of the oils markedly. Copper, lead, and zinc, in general, were corroded to a much greater extent than were any of the other metals. In a number of cases, low-carbon steel, pure magnesium, magnesium AM3S, and tin plate were also less resistant to corrosion than the others. It should be pointed out that some of the metals, such as lead and zinc, were corroded to a greater extent by some oils than by others. However, the aluminum-base alloys were found to be resistant to corrosion in all cases.

The catalytic effect of the various metals increased with increasing temperature. This increase in catalytic effect in general was paralleled by an increase in the amount of corrosion of the metals. There were notable exceptions to these general conclusions, especially in the case of the aluminum-base alloys and stainless steel in that none of these metals had any appreciable catalytic effect on the oils nor did they show any appreciable corrosion.

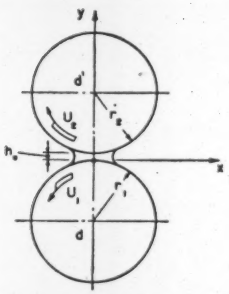
The catalytic effect of a metal appears to be dependent upon its surface area. This is borne out by the tests made with different areas of the aluminum alloy 2S-O and copper simultaneously in contact with the oil. It was found that the catalytic effect on the oil was dependent only on the area of the copper. The presence of aluminum alloys in these tests seemed to be entirely without effect.

The Hydrodynamic Lubrication of Sector-Shaped Pads, by R. S. Brand, Jun. ASME, University of Connecticut, Storrs, Conn. 1951 ASME Semi-Annual Meeting paper No. **51—SA-6** (in type; to be published in Trans. ASME).

SOLUTIONS of Reynolds equation are obtained by means of relaxation methods for a sector-shaped pad. Results are given for a 45-deg "square" sector in the form of curves of operating factors plotted against a parameter of the film shape. A comparison with results based on the solutions for rectangular sliders shows that such solutions can be applied safely to sector-shaped pads in most cases.

The Nonsteady-State Load-Supporting Capacity of Fluid Wedge-Shaped Films, by Ernest K. Gatcombe, Mem. ASME, The United States Naval Postgraduate School, Annapolis, Md. 1951 ASME Semi-Annual Meeting paper No. **51—SA-5** (in type; to be published in Trans. ASME).

A STUDY is presented of the thickness and load-supporting capacity of fluid wedge-shaped films entrapped between the peripheral surfaces of rotating circu-



DISKS POSSESSING ROTARY BUT NO APPROACH MOTION WITH ENTRAPPED FLUID WEDGE

lar disks which are vibrated transversely, causing the wedge-shaped film to become alternately thin, then thick at moderately high frequencies. This nonsteady-state loading of the edge is accomplished by mounting circular disks on parallel shafts with centers at d and d', then transversely vibrating the beam which supports the complete lower-shaft assembly, consisting of bearings, bearing hangers, etc. Part 1 is devoted to a theoretical analysis of the thickness and load-supporting capacity of these fluid wedge-shaped films under steady-state conditions, i.e., for the case where the disks are revolving at constant angular velocities and the lower disk and assembly are not vibrated. Part 2 presents the results of an experimental investigation of these thicknesses and loads under nonsteady-state conditions, i.e., when the disks are simultaneously rotated and the lower one, with its assembly, is vibrated.

Careful instrumentation of this very complex nonsteady-state problem has yielded solutions which have not been obtainable by theoretical studies, except for cases involving assumptions which greatly alter the true results. It is found that the normal approach vibratory motion of the surfaces bounding the film is responsible for a much greater part of its load-supporting action than is the steady-state rotational motion.

Heat Transfer

Heat-Transfer and Pressure-Drop Characteristics of Four Regenerative Heat-Exchanger Matrixes, by A. Ambrosio, C. D. Coulbert, Jun. ASME, R. P. Lipkis, Jun. ASME, P. F. O'Brien, Jun. ASME, and F. E. Romie, Jun. ASME, University of California, Los Angeles, Calif. 1951 ASME Semi-Annual Meeting paper No. 51—SA-34 (mimeographed).

THE regenerative-type heat exchanger, in which the core structure (or matrix) acts as a reservoir of heat for the hot and cold fluids flowing alternately through the same flow passages, shows considerable promise for use as the heat exchanger in a regenerative-cycle gas turbine, or in any installation in which weight and volume are critical considerations. The matrix of such heat exchangers may be constructed of a great many small flow passages, resulting in smaller weight and volume for a specified heat-transfer rate and pressure drop in the regenerator.

This paper covers an experimental investigation of four such possible regenerator matrixes, one made of small cylindrical flow passages, one of flat plates separated by a small gap, and two matrixes of wire screens, each of a different mesh, placed normal to the flow. These matrix configurations were chosen because it can be shown that they have high effectiveness for regenerative-type heat exchangers.

The matrixes were examined, not by the usual steady-state methods, but by a transient method employing a "single-blow" technique. This technique, which more closely approximates conditions in a regenerative heat exchanger, is based on an analytical treatment of such a system by T. E. W. Schumann, and operates as follows: The matrix is heated by hot air to a uniform temperature. The hot air is shut off and cold air is immediately passed through the matrix, the temperature-time history of the air leaving the matrix being recorded. The thermal performance of the matrix can then be evaluated by means of Schumann's solution.

For flat-plate and cylindrical-tube matrixes, the flow was laminar due to the small hydraulic diameter of the flow passages and to velocity limitations imposed by allowable pressure drops. For predictions of pressure drops well-known theoretical treatments suffice, but for heat-transfer rates the usual theoretical predictions, based on constant and uniform wall temperature, must be modified to conform to the more complicated conditions encountered in the regenerator matrixes. In the case of heat transfer from matrixes made of layers of screens, little previous data are available

ASME Transactions for July, 1951

THE July, 1951, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

An Investigation of Flow Through Screens, by W. D. Baines and E. G. Peterson. (50—A-23)

Index Testing of Hydraulic Turbines, by G. H. Voaden. (50—A-52)

The Influence of Reynolds Number on the Performance of Turbomachinery, by Hunt Davis, Harry Kottas, and A. M. G. Moody. (50—A-99)

Nondimensional Study of Proportional-Plus-Reset Control of a Single-Capacity System, by J. A. Hrones and J. B. Reswick. (50—A-42)

An Analysis of Helicopter Propulsion Systems, by J. A. Johnson and R. H. Eustis. (50—SA-45)

The Liquid-Coupled Indirect-Transfer Regenerator for Gas-Turbine Plants, by A. L. London and W. M. Kays. (50—A-89)

Collection and Burning of Locomotive Cinders, by E. J. Boer, J. M. Allen, and B. A. Landry. (50—A-105)

Effect of Internal Pressure on Stresses and Strains in Bolted-Flanged Connections, by D. B. Wesstrom and S. E. Bergh. (50—A-51)

A Design Procedure for Integral Flanges With Tapered Hubs, by W. F. Jaep. (50—A-50)

Formula for Pipe Thickness, by W. J. Buxton and W. R. Burrows. (50—A-62)

A Summary of Viscosity and Heat-Conduction Data for He, A, H_2, O_2, N_2, CO, CO_2, H_2O, and Air, by F. G. Keyes. (50—A-40)

Measurements of the Heat Conductivity of Nitrogen–Carbon Dioxide Mixtures, by F. G. Keyes. (50—A-38)

A Method for the Calculation of Heat Transfer in Solids With Temperature-Dependent Properties, by Robert Plunkett. (50—A-54)

A Study of the Mechanism of Boiling Heat Transfer, by W. M. Rohsenow and J. A. Clark. (50—A-60)

Study of Linear-Resistance Flowmeters, by F. W. Fleming and R. C. Binder. (50—A-37)

Orifice Meters With Supercritical Compressible Flow, by R. G. Cunningham. (50—A-45)

Discharge Coefficients of Small-Diameter Orifices and Flow Nozzles, by H. P. Grace and C. E. Lapple. (50—A-64)

Determination of the Dynamic Coefficient of Friction for Transient Conditions, by G. G. Gould. (50—A-61)

Dynamic Loading of Chain Drives, by W. K. Stamets, Jr. (50—A-25)

Viscosity and Density of Lubricating Oils From 0 to 150,000 Psig and 32 to 425 F, by Donald Bradbury, Melvin Mark, and R. V. Kleinschmidt. (50—A-72)

Performance of Oil-Film Bearings With Abrasive-Containing Lubricant, by A. E. Roach. (50—A-36)

The Effect of Oil Viscosity on the Power-Transmitting Capacity of Spur Gears, by V. N. Borsoff, J. B. Accinelli, and A. G. Cattaneo. (50—A-39)

Strength Behavior of Adhesive Bonds, by H. P. Meissner and G. H. Baldauf. (50—A-20)

Creep Properties of Lucite and Plexiglas for Tension, Compression, Bending, and Torsion, by Joseph Marin, Yoh-Han Pao, and George Cuff. (50—A-19)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Porcelain Enameling on Steel

COMMENT BY G. H. SPENCER-STRONG[1]

Any attempt to thoroughly discuss the technology of porclain enameling[2] within the time allotment of a normal technical paper represents a difficult assignment since the scope of the subject is very broad indeed. The author has done an excellent job in covering the subject; in fact, he has not only covered the technological aspects of the situation most thoroughly, but he has also gone into the history of the art and the application of porcelain enamel, both of which should be of considerable interest.

In attempting to cover such a broad assignment there is always the possibility that the resultant effort may give rise to confusion in the mind of the reader either through an attempt at oversimplification or through overemphasis of minor details. The author has given an excellent discussion of the technological problems of the porcelain-enamel industry. Many of these problems are quite complicated and, in some instances, still subject to debate. Thus, for example, he has briefly and clearly outlined the complicated phenomena involved in the adherence of enamel to steel, a matter which has been the subject of numerous learned papers and, even more, of heated discussions.

The author mentions the work which has been done in the industry in the development and standardization of tests making possible improved control methods and assurance of quality. It may be pointed out that the porcelain-enamel industry as a whole is proud of its standards. The porcelain-enamel plant-control engineers have a standing in the industry which is unusually high. Many of the plants pride themselves on the tightness of the final quality inspection which has come to include not only the parts as finished in porcelain enamel but even the shipping crates and handling methods used in sending the product to the ultimate consumer.

There is one technical phase which the author has not mentioned, probably due to the fact that it is a borderline phase of the industry and usually outside of the control of the porcelain-enameling plants. This is the matter of design. Due to the nature of the product and the processes to which it must be subjected, proper design of products is an extremely important matter in obtaining the fullest value of the porcelain enamel coating. In some plants problems of design are considered jointly by the designers, the plant engineers, and the personnel responsible for porcelain enameling, thereby guaranteeing a result which will be entirely satisfactory. Although in some cases designers have objected to such interference, almost always the end result will be found to be at least as equally as attractive, and sometimes more so, than the original design. The industry has spent a great deal of time in studying this problem, and the Porcelain Enamel Institute has prepared bulletins making recommendations as to the essential features.

The discussion of the properties and the uses of porcelain-enamel coatings is most interesting, although again the author was prevented through limitations of space and time in going into the subject in more than a very general way. He does, however, portray the salient characteristics of the material.

It is hoped that this paper may give rise to interest in new uses for a material which, although centuries old, has just begun to approach its full stature of usefulness.

[1] Research Laboratories, Pemco Corporation, Baltimore, Md.

[2] "The Technology of Porcelain Enameling on Steel," by E. E. Marbaker, MECHANICAL ENGINEERING, vol. 73, May, 1951, pp. 386–392.

Powder Metallurgy Investment Casting

COMMENT BY RICHARD P. SEELIG[3]

An interesting comparison may be made of the fields of application of investment castings as outlined in this paper,[4] and of the powder-metallurgy process.

There are a few materials which can be processed by both, but there are many which can be handled effectively only by either one or the other. Aluminum, stainless steel, high-cobalt alloys are typical examples of alloys best suitable for investment casting. Refractory metals (W), bronze, carbon steel, copper, hard carbides and compound metals call for powder metallurgy as either the only or preferable method.

Precision castings are characterized for their sound and dense structure. Most powder-metallurgy materials are porous, unless they are heavily coined or infiltrated. Where porosity is a desirable property (for self-lubricating bearings, filters, and the like), powder metallurgy is the ideal method of production.

The variety of shapes which can be created by molding of metal powders is limited severely by the lack of flow in the powder. The dies are constructed so that the powder can be filled into the cavity from the top and distributes itself by gravity into the various sections. Pressing takes place from top and bottom only and ejection through the top of the die. In precision casting, certain rules were illustrated in the paper regarding wall thicknesses, and so forth. But compared to powder metallurgy, the variety and complexity of investment castings is infinitely greater. In both fields, size is limited mainly by available equipment, and there are no fundamental reasons why very large or very small pieces cannot be made, if this is economically sound.

While tolerances which can be held in a powder-metallurgy part vary with the direction of pressing, they are, on the average, closer than what can be accomplished in precision casting. In both fields, special care and control can improve the accuracy if justified by increased cost. The surface of investment castings is dense and usually somewhat

[3] American Electro Metal Corporation, Yonkers, N. Y.

[4] "The Fields of Utility of Investment Castings," by R. L. Wood and D. von Ludwig, MECHANICAL ENGINEERING, vol. 73, March, 1951, pp. 191–197.

uneven and rippled (from sandblasting). The surface of sintered parts is porous and has many small dales. But there are no high spots, and the surface is smooth to the touch.

Three other factors are closely connected: Cost, tooling, and quantity of parts to be made. Here again it is clear that the two fields are divergent. It is relatively easy and quick to tool for the lost-pattern casting method. Thus, small quantities can be produced readily, try-out runs are feasible, and changes can be made easily. In powder metallurgy it takes a good deal of time and expense to design, make, and set up dies, but, once they are in operation, production is rapid and requires a minimum amount of handling and supervision. This is strictly a mass-production process, geared to quantities of several thousand, preferably 100,000 pieces or more per run. In this event powder metallurgy is the more economical production process.

In conclusion it can be said that the two methods are rarely in competition with each other. Each has its many and important fields of application and both show signs of increased recognition and continuing growth.

AUTHORS' CLOSURE

Mr. Seelig lists certain alloys which can be handled effectively in investment casting, and others which "call for powder metallurgy as either the only or preferable method." Some of the alloys listed in the second group are being cast in large quantities by the investment process, and it is believed they were included herein by oversight.

The reference is to carbon steel and bronze in particular. We know that large quantities of steel in the No. 1020, No. 1045, No. 1095, and other groups are produced in large quantities by many foundries, and they are also quite common when modified by a great variety of alloys.

As for bronzes, one of the metals run in largest volume in the authors' shop is a high-tensile manganese bronze which is widely used for parts requiring high strength and resistance to vibration, and leakage under pressure.

The choice between investment casting and powder metallurgy, in so far as these two types of metals are concerned, must be made on the basis of other factors, such as those which Mr. Seelig very clearly discusses in the latter part of his comment. If the parts are designed with uniform sections and simple die construction, they should be made out of powder metal unless the quantities are extremely small. But if great complexity is required, or if the quantities are too small to warrant the higher tooling cost of powder metal, investment casting is the better answer.

R. L. WOOD.[b]
D. VON LUDWIG.

[b] Arwood Precision Casting Corporation, Brooklyn, N. Y.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Steam Tables

REVISED STEAM TABLES AND DIAGRAMS OF THE J. S. M. E. The Japan Society of Mechanical Engineers, Tokyo, Japan, 1950. Cloth, 8 × 11½ in., tables, figs., chart enclosed in envelope, 50 pp., 450 yen.

REVIEWED BY F. G. KEYES[1]

THE foreword and explanatory text of the volume appear on the pages in both Japanese and in English. The new tables were sponsored by the Japan Society of Mechanical Engineers through a committee of twenty, organized in October, 1941, of which S. Niwa was chairman.

The carrying out of the detailed operations of formulation, computation, and tabulation was performed by S. Sugawara and I. Tanishita. It will be recalled that the earlier table by Sugawara was based on the 1930 Berlin International Steam Table Conference Skeleton Table. The present table is based upon formulations of the values for steam properties given in the Skeleton Table resulting from the Third International Conference in New York, N. Y., in 1934.

The units employed are degrees centigrade, kilograms per square meter ("absolute pressure"), kilograms per square centimeter (atmospheres), meters cubed per kilogram for volumes, kilogram calories (IT) per kg for enthalpy.

Saturation tables are given both for temperature (each deg C) as argument, and also for pressure (each kg/cm² to 100 and thereon in steps of 5). The values are in excellent accord with the steam tables in use in the United States and also with the 1937 metric-unit-tables by We. Koch of 1937.

The superheat region of steam extends to 300 kg per cm² and begins with 0.01 kg per cm² with increases of 0.01 to 0.10, then successively by 0.02 to 0.40, 0.05 to 0.8, 0.1 to 1.6, and finally by 1 kg per cm² to 100. The increments are 5 from 100 to the end of the tables. The tabulation extends temperatures to 600 C (1112 F). The new tables constitute in the sense of the international conference of 1934 an "international" table, in that the tabulated values correspond at the points of the Skeleton Table with the tolerance set by the committee.

Following the tables are three figures; specific heats of steam for constant pressure, isothermal expansion exponents of steam, and adiabatic expansion exponents of steam; and in addition a Mollier chart in an envelope bound into the volume. A conversion diagram of units is included.

The printing and quality of paper are excellent and the tabulation scheme is convenient.

[1] Professor, Physical Chemistry, Massachusetts Institute of Technology, Cambridge, Mass. ASME Medalist, 1948. Mem. ASME.

Books Received in Library

ASTM MANUAL ON QUALITY CONTROL OF MATERIALS, prepared by ASTM Committee E-11; Special Technical Publication 15-C, January, 1951. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 127 pp., diagrams, charts, tables, $1.75. Replacing the "ASTM Manual on Presentation of Data," this new manual is organized in three parts. Part 1 essentially covers the presentation of data including frequency distributions and simple statistical measures. Part 2 presents limits of uncertainty of an observed average, together with some working rules for rounding off observed results to an appropriate number of significant figures.

Part 3 discusses the control-chart method for the analysis of observational data and for detecting lack of statistical quality control.

APPLICATIONS DE LA MÉTHODE STATISTIQUE DANS L'INDUSTRIE, presented at 26th session, Institut International de Statistique, Berne, Switzerland, 1949; reprinted from Bulletin de l'Institut, volume 32, second part, 1950. Paper, pp. 19–113, charts, tables, paper, 250 Dutch guilders, available from International Statistical Institute, The Hague, Netherlands. The eleven papers contained in this publication were presented at the 1949 meeting of the International Statistical Institute. They describe certain important aspects of the subject, probable future developments, and the progress made in various countries in establishing statistical methods for quality control. Eight of the papers are in English and three in French with summaries in the alternate language.

ATOM MOVEMENTS, a Seminar on Atom Movements at the Thirty-Second National Metal Congress and Exposition, Chicago, Ill., October 21–27, 1950. Sponsored and published by American Society for Metals, Cleveland, Ohio, 1951. Fabrikoid, 6 × 9¼ in., 250 pp., illus., diagrams, charts, tables, $5. Discussing the detailed mechanisms of atom movements, this volume contains papers on various aspects of the diffusion process. It covers several descriptions of the process from various viewpoints; methods for obtaining, analyzing, and presenting diffusion data; diffusion during high-temperature oxidation; diffusion of gases in metals; diffusion during sintering; and grain-boundary migration. A summary of our current understanding of atom movements and suggestions for new experiments are presented.

BASIC THERMODYNAMICS. By C. L. Brown. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, 6 × 9¼ in., 266 pp., diagrams, charts, $4.50. This book is intended for use as a text in a one-semester course in thermodynamics with emphasis on mechanical applications. It develops the first and second laws and then applies them to a study of the devices which convert heat into work or use work to transport heat. It also includes a short section on the elements of heat transmission as they relate to power generation and refrigeration. A knowledge of elementary heat power is assumed.

DIMENSIONAL ANALYSIS AND THEORY OF MODELS. By H. L. Langhaar. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1951. Linen, 6 × 9¼ in., 166 pp., illus., charts, tables, diagrams, $4. This book is devoted to the principles of dimensional analysis which treats the general form of equations that describe natural phenomena. The first four chapters deal with basic principles and develop them mathematically. Chapter 5 covers the theories of similarity and model testing. The remaining five chapters treat specific applications of dimensional analysis. A knowledge of the principles of physics and engineering usually presented in the first three years of an engineering curriculum is assumed.

EFFECTIVE MANAGEMENT THROUGH PROBABILITY CONTROLS, How to Calculate Managerial Risks. By R. K. Mueller. Funk and Wagnalls Co., New York, N. Y., in association with *Modern Industry Magazine*, 1950. Cloth, 6 × 9¼ in., 310 pp., illus., diagrams, charts, tables, $5. A thorough treatment of how statistics can be used to calculate managerial risks, as well as to predict and analyze groups of events in business. It is written from a practical application point of view to guide administrators interested in improving performance in their service, staff, and administrative activities, including finance, personnel, marketing, production, and research.

ELECTRIC POWER STATIONS, volume 2. By T. H. Carr. Third edition. Chapman & Hall, Ltd., London, England, 1951. Cloth, 5½ × 8¾ in., 821 pp., illus., diagrams, charts, tables, 75s. The first two chapters on condensing plant and water treatment continue the material started in volume 1 on the mechanical equipment of (steam) electric power stations. Succeeding chapters give detailed information on alternators, transformers, reactors, switchgear, cables, station auxiliaries, protective equipment, and lubricating, insulating, and fuel oils. The economics and maintenance of stations are considered, and separate chapters deal with hydroelectric, Diesel electric, gas-turbine, wind, atomic, and other types of power plants.

EYES IN INDUSTRY. By D. A. Campbell, W. J. B. Riddell, and Sir A. S. MacNalty. Longmans, Green and Co., New York, N. Y.; London, England; Toronto, Canada, 1951. Cloth, 6¾ × 10 in., 234 pp., illus., diagrams, charts, colored plates, tables, $6.50. Written in clear and simple language, this book deals with the problems of vision, lighting, and color, and stresses the importance of visual efficiency and harmony wherever people work. In three parts: Part 1 describes the structure and function of the eyes and the conditions which influence sight; part 2 considers the nature of eye injuries and the risks to which both agricultural and industrial workers are liable; part 3 is concerned with industrial injuries from the administrative and public-health standpoints.

FLUID MECHANICS. By V. L. Streeter. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1951. Cloth, 6 × 9¼ in., 366 pp., illus., diagrams, charts, tables, $5. Intended for use in a first course in fluid statics and fluid flow, this book develops the material as a continuation of work in mechanics. It treats the broad fluid-mechanics principles underlying turbomachinery, lubrication, jet propulsion, rockets, and oil hydraulic systems. A knowledge of integral calculus and at least two courses in engineering mechanics are assumed. Objective-type problems and questions in addition to numerical problems are included at the end of each chapter.

FOURIER INTEGRAL AND CERTAIN OF ITS APPLICATIONS. By N. Wiener. Dover Publications, New York, N. Y., first American printing of the 1933 edition. Linen, 5½ × 8¼ in., 201 pp., tables, $3.95. This book studies the Fourier integral as a link between harmonic analysis and mathematical theory, physics and engineering. It is based on a series of lectures given at the University of Cambridge in 1932, and considers the relationship of the Fourier transform to the Plancherel theorem, a discussion of an absolutely convergent Fourier Series and of a Tauberian theorem, and the concept of the spectrum. A bibliography is included.

HIGH-SPEED AERODYNAMICS. By W. F. Hilton. Longmans, Green and Co., New York, N. Y.; London, England; Toronto, Canada, 1951. Linen, 6 × 9¼ in., 598 pp., illus., diagrams, charts, tables, $8.50. This comprehensive and up-to-date book covers the principles of high-speed flight and of the design and construction of subsonic and supersonic aircraft and rockets. In four parts: Part 1 is devoted to subsonic and transonic flows; part 2 to supersonic flow; part 3 to wind tunnels; and 4 to general considerations on such topics as thermodynamics, jet propulsion, unsteady flow, and so on.

LABORATORY DESIGNS. Edited by H. S. Coleman. Reinhold Publishing Corporation, New York, N. Y., 1951. Cloth, 9 × 12 in., 393 pp., illus., diagrams, tables, $12. This National Research Council report on design, construction, and equipment of laboratories presents authoritative up-to-date advice and essential data on laboratories for research and educational institutions and for the industries. An effort is made to indicate the constructional materials, facilities, services, and equipment of both teaching and industrial laboratories. Concise descriptions are given of some modern laboratories. A selected bibliography is included.

DER LADUNGSWECHSEL DER VERBRENNUNGSKRAFTMASCHINE. Part 2, Der Zweitakt. (Die Verbrennungskraftmaschine, Band 4, Teil 2.) By H. List. Springer-Verlag, Vienna, Austria, 1950. Paper, 7½ × 10½ in., 370 pp., illus., diagrams, charts, tables, $16.50. Part of an extensive series on internal-combustion engines, this book contains a detailed treatment of the characteristics of a 2-stroke motor. The first and main section is devoted to an examination of the relationship between the cylinder-flow control operations and the charging cycle. In the second and last section, the experimental characteristics of representative commercial motors built by several companies are discussed.

MANAGEMENT OF INDUSTRIAL INVENTORY. By B. Melnitsky. Conover-Mast Publications, Inc., Book Division, New York, N. Y., Chicago, Ill., 1951. Linen, 6 × 9¼ in., 278 pp., diagrams, charts, tables, $4.25. This book, by means of case histories and examples of worth-while practices, portrays the inventory problem in all of its many and varied aspects. The first year evaluates the role of inventory in modern management, presents a brief for centralized control, and stresses the man element in this field. The next section examines the practice rather than the theory of standardization. Then "front office" and the "shop" segments of inventory control are considered. The remainder is concerned with the techniques and methods of physical inventorying.

METAL PROCESSING. By O. W. Boston. Second edition. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1951. Cloth, 6 × 9¼ in., 763 pp., illus., diagrams, charts, tables, $7.50. Providing detailed information on machine processes, accessories and tools, this book illustrates the correlation between design, metals, and manufacturing of a product. This second edition is completely revised with major changes including the substitution of material on surface quality for the chapter on die casting and plastics; an enlargement of the chapters on machinability, machine-tool drives, electric motors, and hydraulic pumps; and new information dealing with sintered-carbide tools and their use.

NEW THEORY OF GRAVITATION. By J. Mandelker. Philosophical Library, New York, N. Y., 1951. Linen, 5½ × 8¾ in., 25 pp., diagrams, $2.75. The author maintains that the outwardly directed radiational force of matter-energy is co-ordinated as the counterforce to the inwardly directed force of gravitation. The mathematical-

physical form and relationship is developed in the main body of the book which includes a theoretical derivation of the gravitational constant. The final chapter presents a natural system of physical units.

DIE ORTSKURVENTHEORIE DER WECHSELSTROMTECHNIK. By G. Oberdorfer. Second edition. Franz Deuticke, Vienna, Austria, 1950. Paper, $6^1/_4 \times 9^1/_4$ in., 100 pp., diagrams, charts, tables, $4. Beginning with introductory mathematical operations involving complex numbers and vectors, this book proceeds to a detailed treatment of the theory of loci with diagrams representing a wide range of conditions. Examples of practical applications in alternating-current calculations are given.

PRACTICAL RULES FOR GRAPHIC PRESENTATION OF BUSINESS STATISTICS. By L. E. Smart and S. Arnold. Second edition, published by Bureau of Business Research, Ohio State University, Columbus, Ohio, 1951. Linen, $6 \times 9^1/_4$ in., 137 pp., illus., diagrams, charts, maps, tables, $2.50. This book presents in a clear and concise manner the essential rules for the correct construction of the most widely used types of business charts. The rules are set forth in outline form with textual discussion reduced to a minimum. One or more charts illustrate applications of each rule treated. This second edition represents an expansion rather than a revision of the earlier edition.

PRODUCTIVITY SUPERVISION, AND MORALE IN AN OFFICE SITUATION. Part 1. By D. Katz, N. Maccoby, and N. C. Morse; published by University of Michigan, Institute for Social Research, Survey Research Center, Ann Arbor, Michigan, 1950. Paper, $5^1/_2 \times 8^1/_2$ in., 84 pp., tables, $2. This report presents the findings of a research project of the Office of Naval Research on group productivity as observed in a business office. It is the first in a proposed series on this subject. This report outlines the study plan, the methods used to obtain data, and the results of the study.

QUANTUM THEORY. By D. Bohm. Prentice-Hall, Inc., New York, N. Y., 1951. Linen, $6 \times 9^1/_4$ in., 646 pp., diagrams, charts, $10. This book provides a basically qualitative and physical presentation of fundamental principles, supplemented with a broad range of specific applications that are worked out in considerable mathematical detail. Parts 1 and 2 present physical and mathematical formulations of the quantum theory. Part 3 is devoted to applications to simple systems, part 4 to methods of approximate solutions of Schrödinger's equation, part 5 to the theory of scattering, and the last part to the quantum theory of the process of measurement.

SERVOMECHANISM AND REGULATING SYSTEM DESIGN, volume 1. By H. Chestnut and R. W. Mayer. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1951. Linen, $6 \times 9^1/_4$ in., 505 pp., diagrams, charts, tables, $7.75. Covering the principles of feedback control, this book, the first of a two-volume set, is adapted to the needs of engineers and engineering students who have not had previous training or experience in the field of closed-loop control systems. It starts with the basic mathematics needed and a description of the nature of the physical problems involved, and proceeds to the solution of advanced designs. Numerous problems illustrate and extend the text material and a bibliography of pertinent references is included.

STRENGTH OF MATERIALS. By F. L. Singer. Harper & Brothers, New York, N. Y., 1951. Linen, $6^1/_4 \times 9^1/_2$ in., 469 pp., diagrams, charts, tables, $5. This book is devoted to the analysis and design of members subjected to axial, torsional, and flexural loads, and combinations of these basic types of loadings. Principles are developed using a consistent plan which first relates stresses to deformations, then applies the equations of static equilibrium, and finally satisfies the boundary conditions. Numerous illustrative problems show in detail how principles are applied, and there are problems for student solution.

SYMPOSIUM ON CORROSION OF MATERIALS AT ELEVATED TEMPERATURES, presented at ASTM Meeting, Atlantic City, N. J., June 26, 1950. (Special Technical Publication No. 108.) American Society for Testing Materials, Philadelphia, Pa., 1951. Paper, 6×9 in., 121 pp., illus., diagrams, charts, tables, $2.25. Sponsored by the Gas Turbine Panel of the ASTM-ASME Joint Committee on the Effect of Temperature on the Properties of Metals, this symposium is composed of eight papers and discussion. The behavior of materials in atmospheres from all the common fuels for mobile and stationary power generation is discussed. The engineering materials considered range from mild steel to ceramics with numerous superalloys in between. The role of protective coatings is also treated.

SYMPOSIUM ON THE RÔLE OF NON-DESTRUCTIVE TESTING IN THE ECONOMICS OF PRODUCTION. Special Technical Publication No. 112 American Society for Testing Materials, Philadelphia, Pa., 1951. Paper, 6×9 in., 157 pp., illus., diagrams, tables, $2.50; to ASTM members, $1.85. The six papers and discussions included in this volume present the actual or potential values of the various well-recognized methods of nondestructive testing in promoting higher quality or more economical production. Two general papers cover historical background, explanations of the various test methods, and generalization on the types of structural irregularities that could be detected. Three papers deal with specific applications of various test methods. The final one includes a general summation which correlates the ideas expressed in the previous papers.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly, to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting May 1, 1951, and approved by the Board July 13, 1951.)

CASE No. 1130

(Special Ruling)

(Interpretations of Pars. H-29, H-62, and H-115)

Inquiry: Since brass is in short supply, may cleanout plugs with threads of ferrous material be considered to comply with Par. H-29, and may steam boilers for domestic service without trycocks be considered to comply with Pars. H-62 and H-115?

Reply: It is the opinion of the Committee that cleanout plugs with threads of ferrous material may be considered to comply with the requirements of Par H-29, and steam heating boilers for domestic service without trycocks may be considered to comply with Pars H-62 and H-115.

CASE No. 1131

(Special Ruling)

Inquiry: Difficulties in procurement have been encountered in obtaining material for boiler stays or braces under Specification SA-31. Are there other material specifications for these parts which would meet the Code requirements?

Reply: It is the opinion of the Committee that the intent of the Code will be met if the material for boiler stays or braces conforms to Specification SA-306-50T, Grades 50, 55, and 60.

NOTE: Only open-hearth or electric furnace steel shall be used.

CASE No. 1133*

Special Ruling

Inquiry: May pressure vessels be built in accordance with Section VIII of the ASME Boiler Code from low carbon nickel?

Reply: It is the opinion of the Committee that low carbon nickel may be

* Applies to both 1949 and 1950 Section VIII

used for the construction of unfired pressure vessels provided the material conforms to Specification SB-162-49T for the low carbon material (0.02 per cent maximum carbon).

The maximum allowable design stress for this material is shown in the following table.

Maximum Design Stress for Low Carbon Nickel SB-162-49T in the Hot Rolled Condition

Temperature	Sub-zero to 500 F	600 F	700 F	800 F
Max. stress psi	8000	7650	7250	6650

CASE No. 1134

Special Ruling

Inquiry: May seamless steel pipe or tubing conforming to the following chemical analysis (including check analysis) and having minimum specified tensile strength, yield strength and elongation shown below be used in the construction of special integrally forged unfired pressure vessels?

	Per cent
Carbon	0.25–0.40
Manganese	0.35–0.90
Phosphorus	0.05 max.
Sulphur	0.05 max.
Silicon	0.15–0.40
Chromium	0.74–1.16
Molybdenum	0.12–0.25

Minimum Specified Tensile Strength—120,000 psi

Minimum Specified Yield Strength—70,000 psi

Minimum Specified Elongation in 2 in.—18 per cent

Reply: It is the opinion of the committee that these materials may be used for the construction of seamless vessels to operate at temperatures between minus 20 F and 150 F and at a maximum stress value of 30,000 psi and that the vessels may be stamped with the code symbol provided the following requirements are complied with:

(1) The material is made by the open hearth or electric furnace process.

(2) There are no stress raisers such as openings, welded attachments, or stampings on the shell portion.

(3) The maximum inside diameter of the shell is 24 in. and the maximum volume of the vessel is 5 cu ft.

(4) The integral heads are hot formed and concave to the pressure.

(5) The openings in the head do not exceed 50 per cent of the outside diameter of the vessel and are not over 3-in. pipe size, and are located in areas of the head where increased thickness and reduced diameter lower the calculated stress to one half or less of the maximum stress in the shell portion.

(6) No welding is utilized.

(7) After all forming operations, vessels are heated to a temperature above the upper critical temperature, but in no case exceeding 1700 F, quenched in oil and then tempered at not less than 1100 F for one hour per inch of thickness but in no case less than one hour.

(8)(a) For batch furnace treatment, one tensile specimen is tested from a ring of material heat treated with each furnace batch or from one of the vessels constituting the batch. If the batch exceeds 200, one tensile specimen shall be tested from each lot of 200 or less.

(b) For continuous furnace treatment, one tensile specimen is tested from a ring of the material heat treated with each lot of 200 or less or from a vessel from each lot of 200 or less. In no case may one tensile specimen represent more than four hours furnace production.

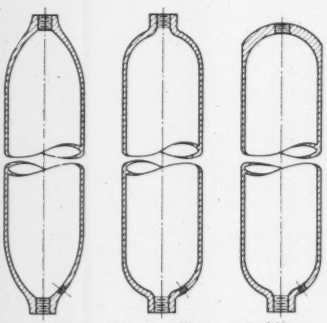
(c) Rings for tensile specimens or vessels from which tensile specimens are cut are from one of the melting furnace heats of steel in the vessels being treated and each melting furnace heat of steel is represented by at least one test.

(d) Recording temperature devices are used and records are made available to the inspector.

(9) The material of the vessel is not subject to corrosion on the interior or exterior.

(10) The vessels comply with all other requirements of Section VIII, 1950 Edition, including requirements for pressure relief devices.

Typical sections of special seamless vessels are shown on sketch.



Openings not to exceed 50 per cent of the outside diameter of the vessel and not over 3 in. pipe size

TYPICAL SECTIONS OF SPECIAL SEAMLESS VESSELS

Errata

Under "Cases Annulled" in MECHANICAL ENGINEERING, December, 1950, the voiding of Case No. 985 referred to the revision of Par. UG-41(b). It should have referred to Par. P-299, Section I, 1949 edition, Par. UA-19, Section VIII, 1949 edition, and Par. UA-46, Section VIII, 1950 edition.

In Case No. 1116, in the section on "Basic Regulations for Tubular Products," Par. 1(b) on Scope, last line, delete reference to (e).

Proposed Revisions and Addenda to Boiler Construction Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets [ ].

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers 1949

PAR. P-21 Replace entire paragraph with the following:

P-21(a) Economizer, boiler generating and superheating tubes shall comply with Specifications SA-83, SA-178, SA-192, SA-209, SA-210, SA-213, SA-226, SA-249, Grades TP304, TP321, TP347, TP316, SA-250, SB-13, and SB-75.

(b) Seamless steel pipe not exceeding $1^1/_2$ in. pipe size complying with Specification SA-53 or SA-106, or seamless steel tubes not exceeding 2 in. outside diameter complying with Specification SA-83 may be threaded into the tube sheet, drum or steel fitting of a water tube boiler. Steel fittings, if used, must fully cover the threads.

(c) A tube in which a fusible plug is to be installed shall be not less than 0.22 in. in thickness at the plug in order to secure four full threads for the plug. (See also Par. A-20)

PAR. P-22 Replace entire paragraph with the following:

P-22(a) The minimum tube thickness at the maximum allowable working pressure for carbon or alloy steel tubes or nipples subjected to internal pressure for water tube boilers, economizers, and superheaters shall be determined from the following formula:

$$T = \frac{D}{2}\left[\frac{Y}{Y+1}\right] + 0.0135D + e$$

The maximum working pressure for a known tube thickness is given by:

$$Y = \frac{P}{S} = \frac{2T - 0.027D - 2e}{D - (2T - 0.027D - 2e)}$$

or

$$P = YS = S\left[\frac{2T - 0.027D - 2e}{D - (2T - 0.027D - 2e)}\right]$$

where

D = Outside diameter of tube, in.
T = Minimum thickness of tube wall, in.
P = Maximum allowable working pressure, psi.
Where the calculated maximum allowable working pressure exceeds an even unit of 10 by more than 1, the next higher unit of 10 may be used
S = Maximum allowable working stress at not less than the maximum expected mean wall temperature m, of the tube wall, which in no case shall be taken at less than 700 F for tubes absorbing heat. For tubes which do not absorb heat the wall temperature may be taken as the temperature of the fluid within the tube but not less than the saturation temperature. Appropriate values of S shall be taken from Table P-5* as revised May 1, 1951
m = Sum of outside and inside surface temperatures divided by 2
$Y = P/S$
e = 0.04 over a length at least equal to the length of the seat plus 1 in. for tubes expanded into tube seats
e = 0 for tubes strength welded to headers and drums

(b) For tubes of the materials listed in its title, Table P-2,* as revised May 1, 1951, may be used in lieu of the formula for determining the minimum thickness of tubes where expanded into drums or headers provided the maximum mean wall temperature does not exceed 700 F.

(c) The thickness of the ends of tubes strength welded to headers or drums need not be made greater than the run of the tube as determined under (a), but the thickness of no tube, where expanded into headers or drums, shall be less than the minimum thickness in Table P-2* for each diameter for which an allowable pressure is tabulated.

(d) The thickness of the ends of pipes or tubes permitted to be attached by threading under the limitations of P-21(b) shall be not less than T as determined under P-22(a), plus $0.8/n$ where n equals the number of threads per inch.

(e) The maximum allowable working pressure of tubes or flues of fire tube boilers shall be as given in Table P-4.*

(f) The maximum allowable working pressure for copper tubes or nipples subjected to internal or external pressure shall be as given in Table P-3.*

The maximum allowable working pressure for copper clad tubes subjected to external pressure shall be determined by the formula in Table P-4,* in which t may be increased by one half the thickness of the cladding.

TABLES P-5 & P-7 For revisions of these tables see Appendix 2 to Revisions.

PAR. P-23(a) Add as a last paragraph:

For boilers installed on the unit system (i.e., one boiler and one turbine or other prime mover) and provided with automatic combustion control equipment responsive to steam header pressure, the value of P for the steam piping shall be not less than the design throttle pressure plus 5 per cent, or not less than 85 per cent of the lowest pressure at which any drum safety valve is set to blow, whichever is greater, and the S value for the material used shall not exceed that permitted for the expected steam temperature at the superheater outlet.

PAR. P-299(e) Insert as a fourth paragraph:

The minimum wall thickness of welding end valves shall be as given in Table E of ASA B16e6—1949.

PAR. P-321 Add as a last paragraph:

The water column shall be so mounted that it will maintain its correct position relative to the steam-water drum under operating conditions.

PAR. A-20(g) Revise to read:

If a fire-actuated fusible plug is inserted in a tube, the tube wall *at the plug* shall be not less than 0.22 in. thick, or sufficient to give four full threads.

PAR. A-52 Revise to read the same as Par. P-295 as follows:

No outlet connections, except for damper regulator, feedwater regulator, drains, steam gages or apparatus of such forms as does not permit the escape of an appreciable amount of steam or water therefrom, shall be placed on the pipes connecting a water column or gage glass to a boiler.

Unfired Pressure Vessels, 1950

PAR. UG-116(a)(3) Delete and substitute:

Maximum design pressure[1]

PAR. UG-116(a) (4) Delete and substitute:

Maximum design temperature[1]

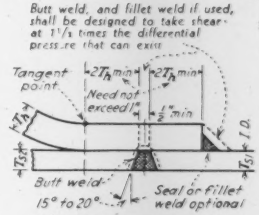
Delete present footnote[1] referring to Par. UG-116(a) (4) and substitute:

[1] Vessels having a maximum temperature in excess of 650 F and an operating cycle such that the maximum pressure and maximum temperature will not occur simultaneously shall be stamped to indicate the maximum design pressure with coincident temperature and also the maximum design temperature with coincident pressure.

PAR. UW-13(c) Add as last sentence:

This construction may also be used for end heads when the thickness of neither shell section exceeds $\frac{5}{8}$ in.

FIG. UW-13(f) This sketch is to be replaced with the one below which is the same as Fig. U-18(d), (1949 edition).



(d) INTERMEDIATE HEAD
(T_{S1} and T_{S2} may be different)

PAR. UW-40(a)(3) Revise second sentence to read:

When the vessel is to be stress-relieved as provided in Par. UW-10, and it is not practicable to stress-relieve the completed vessel as a whole or in two heats, as provided in (2), any circumferential joints not previously stress-relieved may be stress-relieved after welding, by heating them uniformly as required, by any appropriate means over a band having a width neither less than three times the greatest width of the weld groove nor less than four times the shell thickness.

Welding Qualifications 1949

TABLE Q-5 Add to section "P" Number 4 —"O" Number 1 the specification:

SA-299. . . . . Manganese-silicon steel plates

Add to section "P" Number 6—"O" Number 1, the specification:

SA-213 T9 9 per cent chromium-molybdenum seamless alloy steel boiler and superheater tubes.

Material Specifications 1949

EDITORIAL NOTE

The Boiler Code Committee has approved for inclusion in Section II, the ASTM 1950 revisions of SA-157, Specification for Alloy-Steel Castings for Valves, Flanges, and Fittings for High-Temperature Service and SA-306,* Specifications for Medium Carbon Steel Bars, Grades 50, 55, and 60. Stresses for these grades will be the same as for steels now approved in Section I and VIII, of corresponding minimum tensile strength and limited to 650 F. For stresses above 650 F the inquirer is requested to submit data upon which they can be established.

* See Appendix 1 at end of this section.

* Only open hearth or electric furnace steel shall be used.

Appendix 1

TABLE P-2 MAXIMUM ALLOWABLE WORKING PRESSURES FOR SEAMLESS STEEL AND ELECTRIC-RESISTANCE WELDED STEEL TUBES OR NIPPLES FOR WATER TUBE BOILERS, WHERE EXPANDED INTO DRUMS OR HEADERS FOR DIFFERENT DIAMETERS AND GAGES OF TUBES CONFORMING TO THE REQUIREMENTS OF SPECIFICATIONS SA-83, SA-178 GRADE A AND SA-192.

1. These values have been calculated by the formula in P-22 (a) using allowable stress values at a temperature of 700°F, from revised Table P-5 (approved May 1, 1951 by the Boiler Code Committee).
2. Where calculated allowable working pressures exceeded an even unit of 10 by more than 1, the next higher unit of 10 is given in the table.

Tube Outside Diameter, In.		½	¾	1	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4½	5
Wall Thickness In.	Nearest Bwg. No.																		
.055	17–	400	160	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
.065	16	910	480	270	210	160	....	....	....	....	....	....	....	....	....	....	....	....	....
.075	15+	1470	820	520	420	350	230	....	....	....	....	....	....	....	....	....	....	....	....
.085	14+	....	1180	780	650	550	400	290	210	....	....	....	....	....	....	....	....	....	....
.095	13	....	1570	1040	880	750	560	430	340	260	200	160	....	....	....	....	....	....	....
.105	12–	....	....	1320	1120	960	730	570	460	370	300	240	190	....	....	....	....	....	....
.120	11	....	....	1770	1500	1300	1000	800	650	530	450	370	320	270	220	190	....	....	....
.135	10+	....	....	....	1910	1650	1280	1030	840	700	600	510	440	380	330	280	240	....	....
.150	9+	....	....	....	....	....	1570	1260	1040	880	750	650	560	490	430	380	340	260	200
.165	8	....	....	....	....	....	1870	1510	1250	1060	910	790	690	610	540	480	430	340	270
.180	7	....	....	....	....	....	....	1770	1470	1250	1070	930	820	730	650	580	520	420	350
.200	6	....	....	....	....	....	....	....	1770	1500	1300	1130	1000	890	800	720	650	530	450
.220	5	....	....	....	....	....	....	....	....	1770	1530	1340	1180	1060	950	860	780	650	550
.240	4+	....	....	....	....	....	....	....	....	....	1770	1550	1370	1230	1100	1000	910	760	650
.260	3+	....	....	....	....	....	....	....	....	....	....	1770	1570	1400	1260	1150	1040	880	750
.280	2–	....	....	....	....	....	....	....	....	....	....	....	1770	1580	1430	1300	1180	1000	860
.300	...	....	....	....	....	....	....	....	....	....	....	....	....	1770	1600	1450	1320	1120	960
.320	...	....	....	....	....	....	....	....	....	....	....	....	....	1960	1770	1610	1470	1250	1070
.340	...	....	....	....	....	....	....	....	....	....	....	....	....	....	1950	1770	1620	1370	1180
.360	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1930	1770	1500	1300
.380	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1920	1630	1410
.400	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1770	1530
.420	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1910	1650
.440	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1770
.460	...	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1890

(*For Table P-3 see page 675*)

TABLE P-4 MAXIMUM ALLOWABLE WORKING PRESSURES FOR STEEL OR WROUGHT-IRON TUBES OR FLUES FOR FIRE-TUBE BOILERS FOR DIFFERENT DIAMETERS AND GAGES OF TUBES CONFORMING TO THE REQUIREMENTS OF SPECIFICATIONS SA-83 OR SA-178[1]

Size Outside Diameter, In.		1	1½	1¾	2	2¼	2½	3	3¼	3½	4	4½	5	5⅜	5½	6
Wall Thickness, In.	Nearest Bwg No.															
0.095	13	420	280	240	210	190	170	...	...	...	...	...	...	...	...	...
0.105	12	560	380	320	280	250	230	190	180	160	...	...	...	...	...	...
0.120	11	770	520	440	390	350	310	260	240	220	200	180	...	...	...	...
0.135	10+	980	660	570	490	430	400	330	310	280	250	220	200	...	...	...
0.150	9+	...	800	680	600	530	480	400	370	340	300	270	240	230	220	...
0.165	8	...	940	800	700	630	560	470	430	400	350	320	280	270	260	240
0.180	7	...	...	920	810	720	650	540	500	460	410	360	330	300	300	270
0.200	6–	...	...	1090	950	840	760	630	590	540	480	420	380	360	350	320
0.220	5	...	...	1240	1090	970	870	730	670	620	550	490	440	410	400	370
0.240	4+	...	...	1410	1230	1090	990	820	760	700	620	550	490	460	450	410

$$P = 14{,}000\,\frac{(t - 0.065)}{D}$$

where P = maximum allowable working pressure, pounds per square inch,
t = minimum wall thickness, inches,
D = outside diameter of tube, inches

For pressures other than those given in the table, the allowable working pressures shall be the next higher unit of 10 above the values given by the formulas.

For pressures below those given in the table, the gage thickness shall be not less than the minimum given in the table.

[1]These values have been increased to the next higher unit of 10 where the actual value exceed an even unit of 10.

TABLE P-3 MAXIMUM ALLOWABLE WORKING PRESSURES FOR COPPER TUBES FOR WATER-TUBE OR FIRE-TUBE BOILERS CONFORMING TO THE REQUIREMENTS OF SPECIFICATIONS SB-13 AND SB-75[1]

(For use at pressures not to exceed 250 psi or temperatures not to exceed 406 F)

Outside Diam of Tube, Inches	Gage - Bwg								
D	12	11	10	9	8	7	6	5	4
2	170	240	250	250	250	250	250	250	250
3¼	...	...	110	150	220	250	250	250	250
4	...	...	...	...	130	160	250	250	250
5	...	...	...	...	...	...	150	190	230

$$P = 12{,}000 \frac{(t - 0.039)}{D} - 250$$

where P = maximum allowable working pressure, pounds per square inch,
t = thickness of tube wall, inches,
D = outside diameter of tube, inches.

[1]These values have been rounded out to the next higher unit of 10.

APPENDIX 2

Basis for Establishing Stresses for Tables P-5 and P-7 Section I of The ASME Boiler Construction Code

Because of urgency, the revised stress values for Tables P-5 and P-7 are published at this time to make available better utilization of materials containing elements which are, or may be, in short supply.

Supplementary notes, explanatory in character, and the omitted Specification numbers will be available upon request to the Secretary of the Boiler Code Committee.

The basis used in preparing the recommended stresses was adopted by the Subgroup after considering recommendations of the joint EEI-AEIC Committee. This basis was to use the lowest of the following stresses:

(1) One-quarter of the minimum specified tensile strength.

(2) One-quarter of the tensile strength at temperatures as reported by test data.

(3) 62½ per cent of the yield strength at temperature as reported by test data.

(4) A conservative average of the stress to give a creep rate of 0.01 per cent in 1000 hours as reported by test data.

(5) 60 per cent of the average or 80 per cent of the minimum stress to produce rupture in 100,000 hr as reported by test data.

Appendix 2

RECOMMENDED STRESSES FOR TABLE P-5 IN POWER BOILER CODE (Section I)

Carbon Steel

Metal Temperature -F

Specification No.	Grade	Minimum Tensile	-20 to 650	700	750	800	850	900	950
Pipe & Tubes									
SEAMLESS									
SA-53	A	48,000	12,000	11,650	10,700	9,000	7,100	5,000	3,000
	B	60,000	15,000	14,350	12,950	10,800	7,800	5,000	3,000
83	A	(47,000)	11,750	11,500	10,700	9,000	7,100	5,000	3,000
	B	(40,000)	10,000	...	...	...	...	...	...
106	A	48,000	12,000	11,650	10,700	9,000	7,100	5,000	3,000
	B	60,000	15,000	14,350	12,950	10,800	7,800	5,000	3,000
192	A	(47,000)	11,750	11,500	10,700	9,000	7,100	5,000	3,000
210	–	60,000	15,000	14,350	12,950	10,800	7,800	5,000	3,000
ELECTRIC RESISTANCE WELDED									
SA-135	A	48,000[1]	10,200	9,900	9,100	7,650	6,050	4,250	2,550
	B	60,000[1]	12,750	12,200	11,000	9,200	6,650	4,250	2,550
178	A	(47,000)[4]	11,750	11,500	9,100	7,650	6,050	4,250	2,550
	B	40,000[1]	8,500	...	...	...	...	...	...
	C	60,000[4]	15,000	14,350	11,000	9,200	6,650	4,250	2,550
226	–	(47,000)[4]	11,750	11,500	9,100	7,650	6,030	4,250	2,550
LAP WELDED									
SA-53	Steel	45,000[2]	9,000	...	...	...	...	...	...
83	Steel	(45,000)[2]	9,000	...	...	...	...	...	...
83	Iron	– [2]	8,000	...	...	...	...	...	...
106		45,000[2]	9,000	...	...	...	...	...	...
BUTT WELDED									
SA-53	Steel	45,000[3]	6,750	...	...	...	...	...	...
72	Wrought Iron	40,000	6,000	...	...	...	...	...	...

NOTES: [1]These stresses include a weld efficiency factor of .85
[2] " " " " " " " " .80
[3] " " " " " " " " .60
[4] Above 700° these stresses include a welded joint efficiency factor of .85

RECOMMENDED STRESSES FOR TABLES P-5 AND P-7 IN POWER BOILER CODE (Section I)

METAL TEMPERATURES -F

PLATE STEELS

Carbon Steel

Spec.	Grade	Spec. Min. Tensile	-20 to 650	700	750	800	850	900	950	1000
SA-30	Flange	55,000	13,750	13,250	12,050	10,200	7,800	...	...	...
30	Firebox A	52,000	13,000	12,500	11,200	9,600	7,800	5,000	...	...
30	Firebox B	48,000	12,000	11,650	10,700	9,000	7,100	5,000	...	...
SA-129		44,000	11,000	...	...	...	...	...	...	...
SA-201	A	55,000	13,750	13,250	12,050	10,200	7,800	5,000	3,000	1,500
201	B	60,000	15,000	14,350	12,950	10,800	7,800	5,000	3,000	1,500
SA-212	A	65,000	16,250	15,500	13,850	11,400	7,800	5,000	3,000	1,500
212	B	70,000	17,500	16,600	14,750	12,000	7,800	5,000	3,000	1,500
SA-285	C	55,000	13,750	13,250	12,050	10,200	7,800	5,000	...	...
285	A	45,000	11,250	10,900	9,700	8,300	6,600	5,000	...	...
285	B	50,000	12,500	12,100	11,000	9,400	7,300	5,000	...	...

ALLOYS STEELS

Spec.	Type	Min. Tensile	-20 to 450	500	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
209 T1b	Carbon 0.50 Moly	53,000	13,250	13,250	13,250	13,250	13,250	13,250	13,000	12,750	12,500	8,500	5,500	...	...	...	...
209 T1	Carbon 0.50 Moly	55,000	13,750	13,750	13,750	13,750	13,750	13,750	13,450	13,150	12,500	8,500	5,500	...	...	...	...
209 T1a	Carbon 0.50 Moly	60,000	15,000	15,000	15,000	15,000	15,000	15,000	14,400	13,750	12,500	8,500	5,500	...	...	...	...
206 P1	Carbon 0.50 Moly	55,000	13,750	13,750	13,750	13,750	13,750	13,750	13,450	13,150	12,500	...	...	...	...	...	...
204 A	Carbon 0.50 Moly	65,000	16,250	16,250	16,250	16,250	16,250	16,250	15,650	14,400	12,500	...	...	...	...	...	...
204 B	Carbon 0.50 Moly	70,000	17,500	17,500	17,500	17,500	17,500	17,500	16,900	15,000	12,750	...	...	...	...	...	...
204 C	Carbon 0.50 Moly	75,000	18,750	18,750	18,750	18,750	18,750	18,750	18,000	15,900	13,000	...	...	...	...	...	...
280	0.5 Cr 0.50 Moly	55,000	13,750	13,750	13,750	13,750	13,750	13,750	13,450	13,150	12,500	10,000	6,250	...	...	...	...
301	0.5 Cr 0.50 Moly	70,000	17,500	17,500	17,500	17,500	17,500	17,500	16,900	15,000	12,750	10,000	6,250	...	...	...	...
315	1.0 Cr 0.50 Moly	60,000	15,000	15,000	15,000	15,000	15,000	15,000	14,750	14,200	13,100	11,000	7,500	5,000	2,800	...	...
158 P11 } 213 T11 }	1¼ Cr 0.50 Moly	60,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	14,400	13,100	11,000	7,800	5,500	4,000	...	...
158 P3b } 213 T14 }	2 Cr 0.50 Moly	60,000	15,000	15,000	15,000	15,000	15,000	15,000	14,700	14,000	12,500	10,000	6,200	4,200	2,750	...	...
213 T22	2¼ Cr 1.00 Moly	60,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	14,400	13,100	11,000	7,800	5,800	4,200	3,000	...
213 T21	3 Cr 1.00 Moly	60,000	15,000	15,000	15,000	15,000	14,800	14,500	13,900	13,200	12,000	9,000	7,000	5,500	4,000	2,700	...
158 P5a } 213 T5 }	5 Cr 0.50 Moly	60,000	15,000	14,500	14,000	13,700	13,400	13,100	12,800	12,400	11,500	10,000	7,300	5,200	3,300	2,200	1,500
158 P5b	5 Cr 0.50 Moly Si	60,000	15,000	14,500	14,000	13,700	13,400	13,100	12,800	12,400	10,900	9,000	5,500	3,500	2,500	1,800	1,200
158 P5c } 213 T14 }	5 Cr 0.50 Moly Ti	60,000	15,000	14,500	14,000	13,700	13,400	13,100	12,800	12,400	11,500	10,000	5,200	3,400	2,400	1,800	1,500
213 T7	7 Cr 0.50 Moly	60,000	15,000	14,500	14,000	13,700	13,400	13,100	12,500	11,500	9,500	7,000	5,000	3,500	2,500	1,800	1,200
213 T9	9 Cr 1.00 Moly	60,000	15,000	14,500	14,000	13,700	13,400	13,100	12,800	12,500	12,000	10,800	8,500	5,500	3,300	2,220	1,500

Austenitic Alloys

Material	Min. Tensile	-20 to 100	200	300	400	500	600	650	700	750	800	850	900
18 Cr 8 Ni (TS)*	75,000	18,750	17,000	16,000	15,450	15,100	14,900	14,850	14,800	14,700	14,550	14,300	14,000
18 Cr 8 Ni (YS)	75,000	18,750	16,650	15,000	13,650	12,500	11,600	11,200	10,800	10,400	10,000	9,700	9,400
18 Cr 8 Ni Cb	75,000	18,750	18,750	17,000	15,800	15,200	14,900	14,850	14,800	14,700	14,550	14,300	14,100
18 Cr 8 Ni Ti	75,000	18,750	17,000	16,000	15,450	15,100	14,900	14,850	14,800	14,700	14,550	14,300	14,100
16 Cr 13 Ni 3 Mo	75,000	18,750	18,750	17,900	17,500	17,200	17,100	17,050	17,000	16,900	16,750	16,500	16,000

Material	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
18 Cr 8 Ni (TS)*	13,400	12,500	10,000	7,500	5,750	4,500	3,250	2,450	1,800	1,400	1,000	750
18 Cr 8 Ni (YS)	9,100	8,800	8,500	7,500	5,750	4,500	3,250	2,450	1,800	1,400	1,000	750
18 Cr 8 Ni Cb	13,850	13,500	13,100	10,300	7,600	5,000	3,300	2,200	1,500	1,200	900	750
18 Cr 8 Ni Ti	13,850	13,500	13,100	10,300	7,600	5,000	3,300	2,200	1,500	1,200	900	750
16 Cr 13 Ni 3 Mo	13,850	13,500	13,100	10,400	8,500	6,800	5,300	4,000	2,700	2,000	1,500	1,000

* These stresses are permitted when distortion can be allowed without endangering the safety of the structure.

THE ENGINEERING PROFESSION

News and Notes

As Compiled and Edited by A. F. Bochenek

ASEE Concerned Over Engineering Manpower Shortages

1800 Attend Annual Meeting, June 25–29

THE critical shortage of engineering manpower and the need for more adequate use of college research facilities were two themes that ran through most of the 244 papers presented at the 1951 Annual Meeting of the American Society for Engineering Education, held at Michigan State College, East Lansing, Mich., June 25–29, 1951. More than 1800 teachers of engineering and the sciences agreed that the gap between the need for technologists and the sources of supply was widening and that in the battle of ideologies, time was not on the side of the United States.

M. M. Boring, chairman, statistical committee of the Engineering Manpower Committee of the EJC, stated that 60,000 engineers were needed exclusive of the needs of the military. With the colleges expected to graduate 26,000 in 1952, 17,000 in 1953, and 12,000 in 1954, current sources of engineering manpower cannot supply the need, he warned.

Causes of Shortage

Commenting on the causes for the manpower shortage, Mr. Boring said that the increasing complexity of industry and the impact of new technologies of atomic energy, antibiotics, jet propulsion, and others, have increased the use of engineers and scientists, quite independently of war mobilization. The ratio of gainful workers has been increasing since 1890. There is no sign yet that the ratio of engineers to gainful workers, which now stands at 1600 engineers per 100,000 workers, has begun to level off.

Other speakers attributed the shortage to the low birth rate of the 1930's which is now being felt in the colleges, combined with the "unfortunate publicity" early in 1950 about possible future oversupply of engineers.

Another cause cited was the apparent reluctance of students to submit themselves to the rigorous discipline of science.

National Science Foundation

According to A. A. Potter, dean, school of engineering, Purdue University, the nation has reached a stage of such complexity in scientific endeavor and cost of equipment necessary for basic research, that universities and private research foundations have insufficient resources to proceed with creating of new knowledge. Government aid was essential, he said. Many American industries were well equipped to invent and carry on a program of basic as well as applied research but few had the means for long-range basic-research projects for which no immediate gains could be expected.

Dr. Potter, who is one of the engineer members on the National Science Foundation Board, said that the primary responsibility of the Foundation was to develop a sound national policy for the promotion of scientific research and education in the sciences. The second most important task was to evaluate through factual surveys the need for research in the several basic scientific fields with reference to national interest and to provide emergency support in the directions of greatest need.

Dissemination of scientific information was one of the serious problems under consideration by the Foundation. A study to determine in what areas publication facilities are lacking or inadequate; where the gaps exist in major collections of scientific literature; and how these gaps can be closed will be undertaken.

"The Foundation," he said, "also expects to sponsor research to develop new techniques for the quick and economical dissemination of scientific information." Means will also be provided to make possible more travel by American scientists to scientific meetings in other lands in order to broaden their contacts.

S. C. Hollister, Mem. ASME, dean, College of Engineering, Cornell University, Ithaca, N. Y., was elected ASEE president for 1952. A. R. Cullimore, Mem. ASME, president-emeritus, Newark College of Engineering, Newark, N. J., was awarded the 1951 ASEE Lamme Medal.

U. S. Applied Mechanics Congress a Success

MORE than 500 engineers and scientists attended the First U. S. National Congress of Applied Mechanics held at the Illinois Institute of Technology, Chicago, Ill., June 11–16, 1951.

This meeting, the first of its type, was under the sponsorship of the U. S. National Committee on Theoretical and Applied Mechanics, a joint committee of The American Society of Mechanical Engineers, American Institute of Chemical Engineers, Society for Experimental Stress Analysis, American Society of Civil Engineers, Institute of the Aeronautical Sciences, American Mathematical Society, and American Physical Society.

Interest in the meeting was also taken by Illinois Institute of Technology, Armour Research Foundation, Purdue University, Northwestern University, University of Illinois, University of Michigan, Office of Air Research, Office of Naval Research, and Mechanics Division of the American Society for Engineering Education.

The technical program consisted of 27 sessions at which 135 papers were presented. The following branches of the field of applied mechanics were covered: Elasticity, photoelasticity, plasticity, limit design, plates and

DELEGATES WHO ATTENDED THE FIRST U. S. NATIONAL CONGRESS OF APPLIED MECHANICS HELD AT ILLINOIS INSTITUTE OF TECHNOLOGY, JUNE 11–16

shells, creep, fatigue, buckling, dynamics, vibrations, fluid flow, lubrication, and thermal stresses.

A feature of the congress was five general lectures given by the following: E. Orowan on "Creep in Metals and Polymers"; Max Jakob, on "Heat Transfer in Mechanics"; R. von Mises on "Fluid Flow Theory"; J. N. Goodier on "Elastic Stability;" and Theodore von Kármán on "High-Speed Aerodynamics." (Presented by F. Wattendorf.)

Social events included a reception and dance on Monday evening, June 11, at Illinois Institute of Technology, a bus trip, tour of Northwestern University, and a buffet supper on Wednesday afternoon and evening, June 13, and a banquet at the Shoreland Hotel, Chicago, Friday evening, June 15. The selection of Theodore von Kármán as honorary president of the International Union of Theoretical and Applied Mechanics was announced at the banquet. There was also a program of social events for women which included a tea, two luncheons, a fashion show, a card party, tours, and a radio broadcast.

It is planned to hold the next Congress at Ann Arbor, Michigan, in 1954, and thereafter at four-year intervals in the years between the meetings of the International Congresses.

Abstracts of all papers presented will be printed in the September, 1951, issue of the *Journal of Applied Mechanics* of The American Society of Mechanical Engineers.

The Organizing Committee consisted of L. H. Donnell, chairman; Martin Goland; N. M. Newmark, secretary; and Eli Sternberg.

175 Attend Heat Transfer Institute at Stanford University

COUNTRY-WIDE attendance at the three-day meeting of the Heat Transfer and Fluid Mechanics Institute reflected the growing prestige of this annual West Coast event, the fourth meeting of which was held at Stanford University, Stanford, Calif., June 20–22.

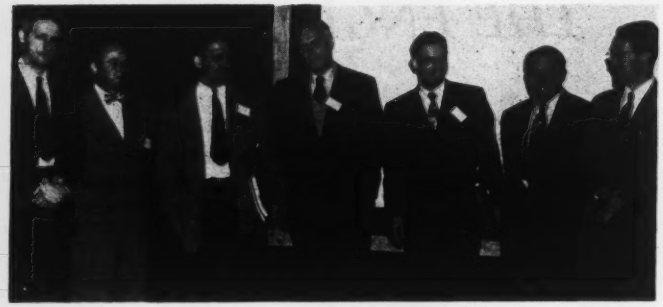
Luigi Crocco of Princeton University, L. M. K. Boelter and R. G. Folsom of the University of California, and R. T. Knapp were among those who took part in the discussion of 18 papers contributed by nine universities and four research laboratories.

Interest centered in papers on unstable combustion of liquid-rocket systems, heat transfer through a convergent-divergent nozzle, and in a series of papers by two research teams working on boiling heat-transfer studies. Other papers presented fundamental information useful to designers of such equipment as pumps, sea breakwaters, chemical-process equipment, citrus-orchard heaters, and jet-propulsion systems.

Preprints Available

Preprint copies of all papers are available and may be ordered from Stanford University Press, Stanford University, Stanford, Calif. Price per set is $5.

It is the policy of the Institute not to publish a proceedings of its meetings but to make available all papers for publication in technical journals.



AT THE 1951 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE HELD AT STANFORD UNIVERSITY, JUNE 20–22

(*Left to right:* Walter Vincenti, Ames Aeronautical Laboratory, NACA, Moffett Field, Calif., C. C. Ross, chief engineer, liquid engines section, Aerojet Engineering Corporation, Azusa, Calif.; A. L. London, Stanford University, general chairman of the Institute; L. P. Saunders, Harrison Radiator Division of General Motors, Lockport, N. Y.; Myron Tribus, Gas Turbine Division, General Electric Company; R. T. Knapp, director, Hydrodynamics Laboratory, California Institute of Technology; and L. M. Trefethen, National Science Foundation, Washington, D. C.)

1952 Institute

The 1952 Institute will be held on the campus of the University of California at Los Angeles, either in June or September, 1952. L. M. K. Boelter has been elected general chairman. V. A. Vanoni of the California Institute of Technology will head the papers committee.

L. A. London, Stanford University, was chairman of the 1951 Institute.

ASHVE Reviews Research Achievements

RESEARCH, like an antiaircraft shell, must be aimed at where the target will be, not where it is now," The American Society of Heating and Ventilating Engineers stresses in a report on its research program in heating, ventilating, and air conditioning published recently under the title "Research: Key to Progress."

The publication traces the far-reaching developments in this field in the past third of a century and describes the current and long-range program of experimentation aimed at further engineering advances for human comfort and health.

The ASHVE has been a pathfinder in its field. In its own laboratory (unique among professional societies) and in educational institutions with which it co-operates in fundamental research, it has pointed the way to progress and sound engineering practice. It has played a leading role in bringing comfortable and healthful environment to homes, schools, and offices.

40 Per Cent of Dues for Research

The Research Laboratory of the Society was established in 1919 in the U. S. Bureau of Mines, Pittsburgh, Pa. In 1944 it was moved to Cleveland, Ohio, and now includes fully-owned and well-equipped offices and experimental facilities, at 7218 Euclid Avenue, with a full-time staff of 30 members. The research program is under the general direction of a 15-member Committee on Research and 20 technical advisory committees.

The Society's research is financed in part by 40 per cent of the annual dues of its 8000 members, supplemented by contributions from industry, individuals, and foundations

The current research program for better control of indoor climate to year-round includes studies in the following subjects: Air cleaning, air distribution, cooling load, environment laboratory, heating loads, heat flow through glass, human calorimeter, industrial ventilation, odors, panel heating and cooling, and sorbents.

Targets for the Future

The laboratory long-range research program of most immediate importance deals with air cleaning, air distribution, combustion, cooling load, heat flow through glass, heat pump, heating loads, hot-water and steam heating, human calorimetry, industrial ventilation, insulation, odors, panel heating and cooling, physiological research, sensations of comfort, sound control, and weather design conditions.

Foundation Created to Study Patents

A PATENT Foundation for research and education in the fields of patent, trademark, copyright, and related systems of law was recently established at The George Washington University Law School, Washington, D. C.

The purpose of the Foundation, which will begin its operations when it has been established on a sound financial basis, will be "to gather and disseminate knowledge regarding the principles, the facts, and the practical

operations of the patent, copyright, trademark, and related systems of law. . . . ."

The organizational phase of the Foundation is being financed through a grant from the Alfred P. Sloan Foundation, New York, N. Y. Among those who have agreed to serve on the Foundation's advisory council are Joseph W. Barker, Mem. ASME, president of the Research Corporation; Vannevar Bush, president of the Carnegie Institute of Washington, and Charles F. Kettering, Fellow ASME, member of the board of directors, General Motors Corporation.

Financial support is expected to come from donations and from membership contributions.

Some of the research projects related to the patent system which may be undertaken by the Foundation when it becomes established are: Patents as invention incentives; patents as affecting the rise and fall of employment; corporate patent policies and profits, and others.

University officials believe that the Foundation's undertakings in research and education have far-reaching potentialities for technological and industrial development and the well-being of the United States. They believe that the Foundation can make for better understanding of the functioning of the patent, copyright, trademark, and related systems of laws in the structure of a free society.

Notes on Coming Meetings

Machine Tools

THE first European machine-tool exhibition will be held at Paris, Sept. 1–10, 1951. Six hundred exhibitors from 12 European and American countries will show over 200 machine tools along with accessory tools and materials needed to operate them. The exhibition is under the sponsorship of the European Committee of Co-operation of Machine-Tool Industries.

Foundry Congress

THE International Foundry Congress will be held in Brussels, Belgium, Sept. 10–14, 1951. Sponsored by the International Committee on Foundry Technical Associations, the congress will discuss new cast-iron structures, testing methods, light alloys, production problems, and foundry education. For further information write to General Secretary, International Foundry Congress, c/o Fabrimetal, 17 Rue des Drapiers, Brussels, Belgium.

Industrial Hydraulics

THE seventh annual National Conference on Industrial Hydraulics will be held at the Sherman Hotel, Chicago, Ill., Nov. 8–9, 1951. The Chicago Section of The American Society of Mechanical Engineers is co-operating with other local groups of national engineering societies in sponsoring these noncommercial discussions.

Safety

INDUSTRIAL Safety sessions of the 39th National Safety Congress and Exposition in Chicago, Ill., Oct. 8–12, 1951, have been assigned to the Stevens, Palmer House, Congress, and Morrison hotels.

Metals

MORE than 500 engineers and scientists from the free nations of the world are expected to attend the World Metallurgical Congress, sponsored by the American Society for Metals. The congress will be held in Detroit, Mich., Oct. 14–19, 1951. The presence of overseas engineers is made possible by the technical assistance program sponsored by the Economic Cooperation Administration. Conservation, utilization, and substitution of strategic metals are among the subjects to be discussed by European authorities.

People

1951 Academic Honors

ALEXANDER G. CHRISTIE, past-president and Hon. Mem. ASME, mechanical-engineering professor-emeritus, The Johns Hopkins University, received the honorary degree of LLD from the university. Others who received academic honors in 1951 are: HARVEY N. DAVIS, past-president and Hon. Mem. ASME, retiring president of Stevens Institute of Technology, DSc degree from Stevens; CARL F. DIETZ, Fellow ASME, FREDERICK P. FAIRCHILD, Fellow ASME, GEORGE W. MERCK, chairman of the board, Merck & Company, and ALTEN S. MILLER, Fellow ASME, received DEng degrees from Stevens Institute of Technology. RALPH E. FLANDERS, past-president and Hon. Mem. ASME, U. S. Senator from Vermont, was awarded a LLD degree by Dartmouth College; ALFRED IDDLES, Fellow ASME, DEng degree, Polytechnic Institute of Brooklyn; CHARLES E. WILSON, Mem. ASME, director of the Office of Defense Mobilization, LLD degree, Harvard University; HOMER ADDAMS, Mem. ASME, DSc degree, Albright College, Reading, Pa.; and ALTON F. DAVIS, Mem. ASME, DSc degree, Mount Union College, Alliance, Ohio.

* * *

WILLIAM F. KIESEL, JR., Mem. ASME, retired mechanical engineer, The Pennsylvania Railroad, was recently awarded a certificate of appreciation by the Altoona (Pa.) Engineering Society.

* * *

KENNETH W. RIDDLE, Mem. ASME, director, Evening College and Diploma School, Drexel Institute of Technology, received the Mary S. Irick Drexel Gold Medal Award at the annual Evening School Honors Night ceremonies, June 8, 1951, for outstanding service to the Institute during the past year.

ELLIOTT DUNLAP SMITH, Mem. ASME, provost, Carnegie Institute of Technology, was elected one of the five new overseers of Harvard University, at the annual commencement meeting of the Harvard Alumni Association held June 22, 1950.

* * *

H. A. SCHWARTZ, Mem. ASME, was awarded the 1951 Charles H. McCrea Medal by National Malleable and Steel Castings Company, Cleveland, Ohio. He was nominated for this honor by the Malleable Founders' Society.

* * *

BORIS A. BAKHMETEFF, Mem. ASME, international authority on hydraulic-engineering and water problems, was named an honorary professor of civil engineering by the trustees of Columbia University. Dr. Bakhmeteff is the fourth person in Columbia's history to be so honored and joins Theodore von Kármán as the only living honorary professors at the university.

* * *

GANO DUNN, Hon. Mem. ASME, by a recent revision of the by-laws of The Cooper Union, New York, N. Y., has had his title changed from president to chairman of the trustees. No change in function or responsibilities is involved.

New Hydraulic Laboratory At M.I.T.

THE Massachusetts Institute of Technology dedicated its new Hydrodynamics and Ship Model Towing Tank on June 4, 1951. According to Arthur T. Ippen, Mem. ASME, director, the laboratory will pursue fundamental studies into the nature of surface resistance, flow patterns, turbulent flow, and fluid mixing processes.

The building contains an unobstructed laboratory space more than 100 feet long and 50 feet wide, two stories high, as well as additional space for offices, shops, darkrooms, lecture room, drafting room, and general service rooms.

Meetings of Other Societies

Aug. 13–15
Society of Automotive Engineers, West Coast meeting, Olympic Hotel, Seattle, Wash.

Aug. 20–23
American Institute of Electrical Engineers Pacific general meeting, Multnomah Hotel, Portland, Ore.

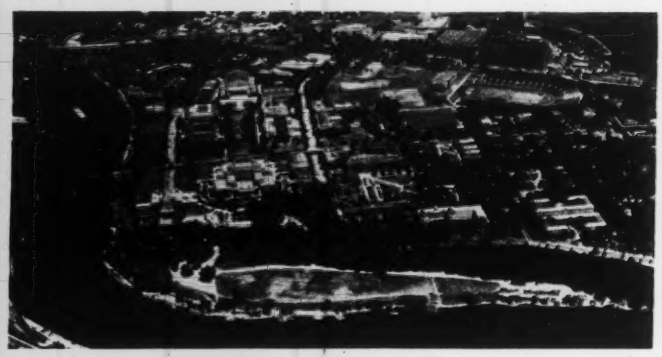
Aug. 26–Sept. 1
Illuminating Engineers Society, national technical conference, Shoreham Hotel, Washington, D. C.

Aug. 27–31
National Association of Power Engineers, national convention and national power show, Sherman Hotel, Chicago, Ill.

Sept. 6–7
The Society of Naval Architects and Marine Engineers, autumn meeting, Statler Hotel, Washington, D. C.

(For ASME Calendar of Coming Events see page 693.)

ASME NEWS



CAMPUS OF THE UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN., MISSISSIPPI RIVER IN THE FOREGROUND

Tentative Program for 1951 ASME Fall Meeting Announced

49 Papers Scheduled for 23 Technical Sessions

THE 1951 Fall Meeting of The American Society of Mechanical Engineers will be held at the Hotel Radisson, Minneapolis, Minn., Sept. 26–28.

The Minnesota Section, with a membership of 300 engineers residing in the states of North Dakota, South Dakota, Montana, and Minnesota, will be host. An interesting program consisting of 23 technical sessions, at which 49 papers will be presented, has been planned by the Society's program-making agencies. In addition there will be a series of luncheons and a banquet, a special program for the women attending the meeting, and plant-inspection trips to some of Minneapolis' finest industrial plants.

Midwest Industrial Center

As one of the largest industrial centers in the Midwest, Minneapolis offers a great deal of interest to mechanical engineers. The products of its flour mills and linseed-oil industry are shipped throughout the world. The city is an important producer of agricultural machinery, fabricated metal products, electric machinery, and domestic electric utilities. Some 400 printing and publishing establishments in Minneapolis make it one of the largest publishing centers in the United States. Paralleling its industrial achievements, Minneapolis boasts of the University of Minnesota and the Minneapolis Symphony Orchestra, institutions which are of world renown.

Junior Conference

The Junior Conference on Wednesday evening provides an opportunity for young engineers in the Minnesota Section to participate in the project sponsored by the National Junior Committee of bringing together seasoned engineers and recent graduates for informal discussions on topics of professional development. Fred T. Agathe, process engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., will address the Junior Conference on the general theme, "A Current Plan for Young Engineers." Eight Junior members, each representing one of the Sections in Region VI, will start off the general discussion. These men are: *Nebraska*, J. L. Birkheimer; *Central Iowa*, R. H. Burgan; *Rock River Valley*, J. G. Floden; *Chicago*, John Noble; *Iowa-Illinois*, Newton N. Sacks; *Central Illinois*, C. L. Sonnenschein; *Milwaukee*, Ray Sullivan; *Fort Wayne*, J. C. Willsey.

The National Junior Committee is supported financially by the Old Guard Committee of the Society.

Women's Program

A fine program has been arranged by the women of the Minnesota Section. This will include a sight-seeing tour of the Twin Cities, the University, local parks, and lakes. At noon there will be a luncheon at Sibley House, a historic point on the Mississippi River near Fort Snelling. On Wednesday evening the women will have an opportunity to tour the plant of Brown & Bigelow. On the following day there will be a tour of Daytons, one of Minneapolis' largest department stores. A feature of the visit will be inspection of special shops, gallery, and kitchen.

Plant Trips

As an important Midwestern industrial center, Minneapolis offers an excellent opportunity for inspection trips to some of America's finest industrial plants. In addition to the technical program, the Fall Meeting will offer five visits. (1) Brown & Bigelow, St. Paul, manufacturers of novelties and printers of picture advertising and calendars; (2) General Mills, Inc., where members will see one of the foremost milling centers in the country; (3) Minneapolis-Honeywell Regulator Company, manufacturers of instruments for heating, ventilating, and air conditioning, aeronautical use, and research; (4) Minneapolis-Moline Company, manufacturers of farm machinery and industrial power units; and (5) the Hydraulics Laboratory of the University of Minnesota. This laboratory is situated at the site of the historic St. Anthony Falls on the Mississippi River. It is served by actual river flow.

Calvin Rice Lecture

Frederick Oederlin, managing director, charge of engineering, Sulzer Brothers, Inc., Winterthur, Switzerland, will deliver the Calvin W. Rice Lecture on Wednesday at 5 p.m. This lecture honors the man who served as secretary of the ASME from 1906 until his death in 1934. Mr. Rice devoted his life to increased understanding between engineers of various countries.

Roy V. Wright Lecture

The Roy V. Wright Lecture will be presented at a luncheon on Thursday by John W. Barriger, 3rd, president, Chicago, Indianapolis and Louisville Railway, Chicago, Ill. This lecture honors the late Dr. Wright, president of the Society in 1931, who worked to impress upon engineers and young people the duties, responsibilities, and privileges of citizenship.

Technical Program

The technical program follows:

WEDNESDAY, SEPTEMBER 26

8:00 a.m.

Registration

9:30 a.m.

Management (I)—SAM

Relating Industrial Research to the Company, by *Waldo Kliever*, director of research, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

An Approach To Training First-Line Production Management, by *Edgar Scott Howard*, manager production training, Minnesota Mining and Manufacturing Company, St. Paul, Minn.

Industrial Growth and Corporate Taxation, by *Joseph F. Manilds*, assistant professor, department of engineering, University of California, Los Angeles, Calif.

9:30 a.m.

IIRD (I)

Effect of Eccentricity on Instrument-Gear Accuracy, by *Richard L. Thoen*, mechanical division, General Mills, Inc., Minneapolis, Minn.

An Indicating and Controlling Pyrometer, by *E. W. Clark* and *J. K. Sidebottom*, General Electric Company, Lynn Works, West Lynn, Mass.

Power (I)

Recent Developments in Industrial Turbines, by *Arthur D. Somes*, division engineer, turbine and gear division, General Electric Company, Lynn, Mass.

Effect of Exhaust Pressure on the Economy of Condensing Turbines, by *Jack E. Downs*, section engineer, General Electric Company, Schenectady, N. Y., and *Allen Keller*, steam-turbine engineer, River Works, General Electric Company, Lynn, Mass.

9:30 a.m.

Production Engineering (I)

Machinability Evaluation of SAE 1045 Steel on Turning Tests, by *L. C. Hays*, Case Institute of Technology, Cleveland, Ohio.

Blazing Aids the Building of Transformers, by *Lawrence David Jennings*, mechanical engineer, Westinghouse Electric Corporation, Sharon, Pa.

9:30 a.m.

Heat Transfer

Line-Reversal Techniques in the Determination of Temperature of Gun Flash or Other Rapid-Transient Phenomena, by *John T. Agnew*, professor of mechanical engineering, Purdue University, Lafayette, Ind., *R. E. Benn* and *R. G. Franklin*, The Franklin Institute Laboratories, Philadelphia, Pa. (No. 51—F-6)

Distribution of Heat-Transfer Coefficients Around Circular Cylinders in Crossflow at Reynolds Numbers From 20 to 500, by *E. R. G. Eckert*, scientist, National Advisory Committee for Aeronautics, Cleveland, Ohio, and *Erich Soehngen*, U. S. A. F. Flight Research Laboratory, Wright Field, Dayton, Ohio. (No. 51—F-9)

12:15 p.m.

President's Luncheon

Presiding: *The President, J. Calvin Brown.*

Speaker: *Warren Courtland MacFarlane*, president, general manager, Minneapolis-Moline Power Implement Company, Minneapolis, Minn.

Subject: **Welcome to Northweat Where Agriculture and Industry Meet.**

2:30 p.m.

Power (II)-Fuels (I)

Steam-Generating Unit Design for Burning Coals From the Northern Great Plains Province, by *Otto de Lorenzi*, director of education, fuels consultant, and *John H. Cruise*, proposition engineer, Combustion Engineering-Superheater, Inc., New York, N. Y.

2:30 p.m.

Education—Minnesota Society for Professional Engineers

Postgraduate Education of Engineers in Industry, by *John Gammell*, supervisor, sales training, general machinery division, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Round Table on Engineering Education

Speakers: *Charles E. Doell*, superintendent of parks, Minneapolis, Minn.; *Hibbert Hill*, chief engineer, Northern States Power Company, Minneapolis, Minn.; and *Julius M. Nolte*, dean, University Extension, University of Minnesota, Minneapolis, Minn.

2:30 p.m.

IIRD (II)-Petroleum (I)

A Method for Controlling Moisture Content of Foundry Sand, by *A. M. Severson* and *J. J. Uppgren*, instructors in materials and processing division, mechanical-engineering department, University of Minnesota, Minneapolis, Minn.

2:30 p.m.

Safety-Management (II)

Accident Prevention and Safety—An Engineering Subject? by *Niles Hutton Barnard*, professor, mechanical-engineering department, University of Nebraska, Lincoln, Neb. (No. 51—F-1)

Management is Initiated for Safety, by *Charles A. N. Armstrong*, supervising engineer, The Ocean Accident and Guarantee Corporation, Ltd., Omaha, Neb.

5:00 p.m.

Calvin W. Rice Lecture

Presiding: *The President, J. Calvin Brown*

Lecturer: *Dr. Frederick Oederlin*, managing director, charge of engineering, Sulzer Brothers, Ltd., Winterthur, Switzerland.

Subject: **Engineering Achievements in Switzerland and Their Background.**

7:00 p.m.

Inspection Trip

Brown and Bigelow, St. Paul, Minn.

8:00 p.m.

Junior Conference

Subject: **A Current Plan for Young Engineers.**

Speaker: *Fred T. Agthe*, process engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

THURSDAY, SEPTEMBER 27

9:30 a.m.

Fuels (II)-Power (III)

Operation of Large Power Boilers With Lignite Coals From The Dominion of Canada and Northern United States, by *John M. Drabelle*, chief engineer, Iowa Electric Light and Power Company, Cedar Rapids, Iowa, and *John W. Hoffman*, assistant results engineer, Northern States Power Company, Minneapolis, Minn.

Basic Elements of Design and Operation of Steam-Generating Units for Utilization of North Dakota Lignites in Central Station Practice, by *Leopold Pastner*, vice-president, Fuel Economy Engineering Company, St. Paul, Minn.

Current Research On Lignite, by *Alex C. Burr*, chief, fuels-technology division, U. S. Bureau of Mines, Grand Forks, N. Dak.

9:30 a.m.

Process Industries-Petroleum (II)

Determination of Dust Concentrations in Flour Mill Suction Systems, by *John M. MacKenzie*, assistant professor, mechanical-engineering department, University of Minnesota, Minneapolis, Minn.

Measurement of Particle-Size Distribution in Flour, by *Kenneth T. Whitby*, instructor mechanical-engineering department, University of Minnesota, Minneapolis, Minn.

Lubrication of Flour-Milling Machinery, by *C. A. E. Gower*, Socony Vacuum Oil Company, Inc., Kansas City, Mo.

9:30 a.m.

Machine Design (I)

Characteristics of Dished-Plate (Belleville) Springs as Measured in Portable Recording Tensiometers, by *James J. Ryan*, professor of mechanical engineering, University of Minnesota, Minneapolis, Minn. (No. 51—F-2)

The Theory of Long-Deflection Constant Force Spring Elements, by *Frank A. Votta, Jr.*, design engineer, Hunter Spring Company, Lansdale, Pa. (No. 51—F-11)

9:30 a.m.

Production Engineering (II)

The Tooling of an Automatic Transmission, by *Stanley F. Steiner*, manager of industrial engineering, Automatic Transmission Plant, Ford Motor Company, Highland Park, Mich.

Angles for Machining, by *M. F. Spotts*, professor of mechanical engineering, mechanical-engineering department, Northwestern University, Evanston, Ill.

12:15 p.m.

Roy V. Wright Luncheon and Lecture

Presiding: *The President, J. Calvin Brown*

Introduction: *James Lewis Morrill*, president, University of Minnesota, Minneapolis, Minn.

Lecturer: *John W. Barriger, 3rd*, president, Chicago, Indianapolis and Louisville Railway, Chicago, Ill.

2:30 p.m.

Machine Design (II)-Petroleum (III)

Serviceability of Paper-Machine Lubricants, by *M. L. Langworthy* and *Bruce Weetman*, Texas Company, New York, N. Y.

The Machine-Tool Laboratory at the University of Illinois, by *Lawrence E. Doyle*, assistant professor, mechanical engineering, College of Engineering, and *W. C. Deem, Jr.*, University of Illinois, Urbana, Ill. (No. 51—F-10)

SKYLINE OF MINNEAPOLIS AS SEEN FROM LORING LAKE, ONE OF MINNEAPOLIS' 22 LAKES AND LAKELETS

2:30 p.m.

Fuels (III)-Materials Handling (I)

Coal Handling Conveyers at Powerhouse and Dock, by *Frank W. Lovett*, engineer, power-plant equipment, Link-Belt Company, Chicago, Ill.

Storage of Coal, by *William L. Lundy*, staff steam engineer, Kimberly-Clark Corporation, Neenah, Wis.

2:30 p.m.

Power (IV)-Boiler-Feedwater Studies

Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater, by *Vincent Joseph Calise*, technical director, and *R. K. Stenard*, Graver Water Conditioning Company, New York, N. Y.

Industrial Plant Boiler-Feedwater Treatment, by *D. C. Carmichael*, senior power engineer, design division, E. I. du Pont de Nemours and Company, Wilmington, Del.

2:30 p.m.

American Rocket Society

The Properties and Production of Concentrated Gaseous and Liquid Ozone, by *Clark E. Thorp*, chairman, department of chemistry and chemical engineering, Armour Research Foundation, of Illinois Institute of Technology, Chicago, Ill.

The Effects of Several Variables Upon the Ignition Lag of Hypergolic Fuels Oxidized by Nitric Acid, by *Stanley V. Gunn*, Purdue Rocket Laboratory, Lafayette, Ind.

2:30 p.m.

Inspection Trips

Minneapolis-Moline Power Implement Company, Minneapolis and Hopkins, Minn.

University of Minnesota; Hydraulics Laboratory

6:15 p.m.

Reception

7:00 p.m.

Banquet

Speaker: *The President, J. Calvin Brown*

FRIDAY, SEPTEMBER 28

9:30 a.m.

Metals Engineering (I)

Peculiar Behavior of Steel Beams Under Dead Loads That Produce Inelastic Strains, by *Omar M. Sidebottom*, special research associate, and *M. E. Clark* and *H. E. Corten*, instructors in theoretical and applied mechanics, University of Illinois, Urbana, Ill. (No. 51—F-4)

An Experimental Investigation of Overstraining in Mild-Steel Thick-Walled Cylinders by Internal Fluid Pressure, by *Monigomerie C. Steele* and *John Young*, research assistant, University of Illinois, Urbana, Ill. (No. 51—F-3)

9:30 a.m.

Materials Handling (II)-American Society of Agricultural Engineers

Cranes and Hoist Equipment for the Contracting Field, by *Robert J. Stoddard*, chief engineer, American Hoist and Derrick Company, St. Paul, Minn.

Engineering and Design of Farm Machinery, by *C. E. Frudden*, consulting engineer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

9:30 a.m.

Gas Turbine Power (I)

A Contribution to the Problem of Designing Radial Turbomachines, by *O. E. Balje*, stratos division, Fairchild Corporation, Farmingdale, L. I., N. Y.

Theory of the Radial Inflow Turbine, by *P. Frank Martinussi*, professor, mechanical engineering, Sibley School of Mechanical Engineering, Cornell University, Ithaca, N. Y. (No. 51—F-15)

2:30 p.m.

Gas Turbine Power (II)-Hydraulic

Some Theoretical Aerodynamic Investigations of Impellers in Radial and Mixed-Flow Centrifugal Compressors, by *John D. Stanitz*, head, Applied Analysis Section of Compressor and Turbine Research Division, National Advisory Committee for Aeronautics, Cleveland, Ohio. (No. 51—F-13)

Single-Stage Radial Turbines for Gaseous Substances With High Rotative and Low Specific Speed, by *W. T. Von der Nuell*, Airesearch Corporation, Los Angeles, Calif. (No. 51—F-16)

2:30 p.m.

Materials Handling (III)

Portable Conveyers in an Emergency Economy, by *R. F. Tomlinson*, general sales manager, A. B. Farquhar Company, York, Pa. (No. 51—F-8)

Coal and Ore Transfer From Rail Car to Lake Vessel, by *E. E. Bauer*, contracting engineer, Heyl and Patterson, Pittsburgh, Pa. (No. 51—F-14)

2:30 p.m.

Metals Engineering (II)

The Forging of Artillery Shells, by *Willibald Trinks*, partner, Associated Engineers, Pittsburgh, Pa. (No. 51—F-7)

Dynamic Properties of Nodular Cast Iron, by *Harry Majors, Jr.*, director, Engineering Experiment Station, University of Alabama, University Ala. (No. 51—F-5)

2:30 p.m.

Inspection Trips

General Mills, Inc., Minneapolis, Minn.

Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

ASME Petroleum Division Prepares for Sixth Annual Conference

THE Sixth Annual Petroleum Mechanical Engineering Conference of the Petroleum Division of The American Society of Mechanical Engineers will be held at the Mayo Hotel, Tulsa, Okla., Sept. 24–26, 1951.

A technical program consisting of 40 papers is planned by the operating committees of the Division. While the program is not far enough advanced for formal announcement, an idea of the wealth of new ideas and reports that will come under discussion can be obtained from the following summaries of the three main divisions of the program: Production, transportation, and refining.

Production

The following papers are tentatively scheduled for production sessions: Theoretical Analysis of Sucker-Rod Loads; Long-Stroke Surface Hydraulic Pumping Units; Air-Balanced Pumping Units; New Percussion Drilling Tool for Rotary Rigs, Effect of Rock Properties on Drilling, History of Magnetic Exploration, New Developments in Design and Construction of Offshore Platforms, Recent Developments in Low-Temperature Separation, The Kinematics of Pumping Units, Slush-Pump History and Possible Development; Gas Dehydration, New High-Yield-Strength Alloy Steel, Less Familiar Metals of Commercial Importance, and Forgings.

Transportation

The transportation sessions will take up the following subjects: Differential Head Meters, Measurement of Crude Oil by Positive-Displacement Meters, Welding Thin-Wall High-Strength Pipe, Welding Qualities of High-Yield-Point Pipe, Development of Metal-Arc Electrodes, Power-Operated and Remote-Controlled Valves, Testing and Operation of Relief Valves, Valves to Combat Corrosion in Industry, Dual-Fuel Conversion of Existing Type Diesel, High-Compression Spark-Ignited Gas Engines, Fuel-Vaporizer Equipment, Application of Pipe-Line Control Equipment to Field, Remote Supervisory Control of Field Stations, Water-Cooling Towers in Petroleum Industry, and Techniques of Cost Estimating for Refineries.

Refining

A feature of the conference will be a symposium on pilot-plant design tentatively scheduled for a refining session. This symposium will present the academic phase of the problem with a paper by an educator, the oil company's view by an engineer from one of the major oil industry's research and development centers, and the independent viewpoint by a representative of refinery designers and contractors.

Other papers tentatively listed for the refining sessions are: Vinyl-Resin Coatings in Petroleum Refineries, Corrosion Resistance of Alloys in Amine Gas, Analysis of Corrosion Problems in Refineries, Automatic Control of Flow in Refineries, Modern Instrumentation Aids Economy in Carbon B, Performance of High-Pressure Instruments, Results of Fatigue Tests on Welding Piping Assemblies, Interaction of Pressure and Bending at Pipe Flanges, Stresses in Pressure Vessel With a Conical Head, Redesign of Mechanical-Seal Retaining Assemblies, and Packing Studies.

F. J. Daasch of the Gulf Oil Corporation, Tulsa, Okla., is in charge of local arrangements.

In addition to technical sessions, the program will include inspection trips to the Mid-Continent Oil Company Refinery at Tulsa, Phillips Petroleum Research Center in Bartlesville, with an evening buffalo-beef barbecue on the Phillips' Woolaroc Ranch, and a banquet which will be addressed by a nationally prominent oil-industry figure.

The ASME Petroleum Division concerns itself with the mechanical-engineering problems of the petroleum industry. Through its programs and committee activities it provides a form for free discussion of the complex mechanical problems arising in the industry. The Division divides the mechanical aspects of design and operation under the following items: production, transportation, refining and application. Chemical and process problems of the petroleum industry are not considered.

Mechanical engineers active in the petroleum industry are invited to become members of the Division. Write to Joseph M. Sexton,

Manager, inspection department, The M. W. Kellogg Company, 225 Broadway, New York 7, N. Y., who is chairman of the Division.

IIRD National Conference Scheduled for September

A PANEL discussion on the relation of cybernetics to industrial control will be a feature of the Sixth National Conference of the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers.

The conference will be a part of the annual program and exhibit sponsored by the Instrument Society of America to be held in Houston, Texas, Sept. 10–15, 1951. The IIRD program will consist of three technical sessions and one luncheon.

The tentative program follows:

MONDAY, SEPTEMBER 10

9:30 a.m.

Aviation Instruments

Multiresponse Totalizing System, by *J. E. Bevins*, Eclipse Pioneer Division, Bendix Aviation Corporation.

Analysis and Synthesis of the Lateral-Control Problem, by *R. N. Bretoi*, aero division, Minneapolis-Honeywell Regulator Company.

TUESDAY, SEPTEMBER 11

9:30 a.m.

Geophysical Instruments

Instrumentation in Exploration Geophysics, by *R. D. Wykoff*, Gulf Research and Development Company.

Geomagnetic Instruments, by *Walter Ruska*, Ruska Instrument Corporation.

Seismic Instrumentation, by *John Monkhouse*, Rodgers-Ray, Inc.

New Precision Barometer and Barograph, by *C. A. Heiland*, Heiland Research Corporation.

Luncheon

12:30 p.m.

Hotel Rice

Cybernetics

2:30 p.m.

Panel Discussion on "The Relation of Cybernetics to Industrial Control." Principal Discusser: *Norbert Wiener*, Instituto Nacional de Cardiologia of Mexico City, professor of mathematics, Massachusetts Institute of Technology, and others.

According to Alfred F. Sperry, president, Panellit Corporation, chairman of the Division, the conference should be of interest to mechanical engineers concerned with instrumentation in the aviation industry, the oil industry, and the field of industrial control. The IIR Division, he said, offers men in the instrument industry an opportunity to participate in research projects, bibliographical projects, and program planning. Attendance at the Division's meetings will encourage IIRD authors.

R. S. Leith Wins Award

IN a papers competition sponsored by the ASME Baltimore Section, Robert S. Leith, of The Johns Hopkins University, won first prize which consisted of a certificate of merit and an engineering reference book.

You Can Afford the 1951 ASME Annual Meeting at Atlantic City, Nov. 25–29

LATE NOVEMBER, WHEN THE 1951 ASME ANNUAL MEETING WILL BE HELD AT ATLANTIC CITY, IS A SEASON OF BRIGHT SKIES AND MILD TEMPERATURES

(The winter season is a time of relaxation at Atlantic City and an ideal time for engineers to get together for discussions and society business. Hotels and shops are open but uncrowded. There is relaxation also in price levels and good rooms, and reasonable eating houses are always close at hand. Four years ago, when the ASME held its first annual meeting in years outside of New York, there was some skepticism about the choice of Atlantic City, but when the meeting was over, many who were first in doubt were first in their enthusiasm for what Atlantic City contributed to the meeting. More persons attended technical sessions; discussions were more animated and to the point; social events were better attended; and nobody was watching the clock to rush away for an appointment. No wonder the ASME is going back to Atlantic City in 1951! But best of all, Atlantic City is not expensive during the winter season. Anyone who can afford a few days in New York will find his budget unscarred by an Annual Meeting in Atlantic City.)

Philadelphia Section Names Annual Meeting Committee

THE Philadelphia Section of The American Society of Mechanical Engineers, host Section for the 1951 Annual Meeting to be held in Atlantic City, N. J., Nov. 25–30, 1951, has appointed the following committee to be responsible for arrangements:

Chairman, L. R. Gaty, manager, engineering department, Philadelphia Electric Company; *vice-chairman*, C. B. Campbell, manager engineering, steam division, Westinghouse Electric Corporation; *treasurer*, S. Littlejohn, district manager, industrial division, General Electric Company; entertainment, W. E. Belcher, Jr., senior development engineer, The Brown Instrument Company; *science theater*, W. F. Coles, Jr., mechanical engineer, H. M. Wilson, and C. M. Hagan, vice-president, Atlantic City Electric Company, N. J.; *information and reception*, T. W. Hopper, engineering manager, Day and Zimmermann; *reception for honored guests*, E. L. Hopping, Havertown, Pa., and K. M. Irwin, vice-president, Philadelphia Electric Company; *publicity*, B. F. Keene, district manager, Leeds & Northrup Company, and S. T. Mackenzie, assistant sales manager, Babcock & Wilcox Company, New York, N. Y.; *technical events*, J. J. McCarthy, Philadelphia representative, Cochrane Corporation; *finance*, F. W. Miller, works manager, Yarnall Waring Company; *student aides*, H. D. Moll, field engineer, Elliott Company, D. W. R. Morgan, vice-president, Westinghouse Electric Corporation, and A. W. Thorson, supervising engineer, United Engineers and Constructors; *annual dinner*, B. W. Webb, Philadelphia district manager, Combustion Engineer-Superheater, Inc.; and *women's activities*, Mrs. R. W. Worley.

Guide to Taylor Collection Published by ASME

A GUIDE to the papers and personal library of Frederick Winslow Taylor, president ASME (1906) and founder of the "Taylor" system of scientific management, now housed in the Stevens Institute of Technology, Hoboken, N. J., was recently published by The American Society of Mechanical Engineers.

The guide was prepared by Elizabeth Gardner Hayward, Stevens Librarian, to facilitate the fullest possible use of the Taylor collection. It is arranged in three parts covering the life and work of Taylor, his principles of scientific management and the details of the system itself.

Copies of the 45-page guide may be ordered from ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price is $3.

ASME Holds 1951 Semi-Annual Meeting At Toronto, Canada

Norris R. Crump Receives Honorary Membership

THE 1951 Semi-Annual Meeting, which was held at the Royal York Hotel, Toronto, Ont., Canada, June 10–14, attracted some 1200 members and guests. It was notable chiefly for the excellence of the arrangements, the friendliness of the hosts, and the high quality of dignity and impressiveness that marked the social events. The cordiality of relationships which exist between The Engineering Institute of Canada and The American Society of Mechanical Engineers is typical of the relationships between the two great nations which live in harmony and under the blessings of peace on both sides of the border.

Luncheons Feature Eminent Speakers

At all luncheons and dinners citizens of both countries were prominently featured. At the President's Luncheon on Monday, June 11, J. Calvin Brown, president ASME, paid tribute to Canada's contributions to engineering and to Canadian engineers. The Roy V. Wright Lecture, which was the feature of the luncheon on Tuesday, was delivered by C. J. MacKenzie, president, National Research Council, Ottawa, Canada. Dr. MacKenzie, in an address, "The Engineer and His Community," carried the subject into the realm of international relations. The text of his address will be published in a later issue of this magazine. President Brown presided and the speaker was introduced by H. B. Speakman of the International Research Foundation, Toronto.

On Wednesday, Ira P. Macnab, president, The Engineering Institute of Canada, spoke at the EIC-ASME joint luncheon. His subject was "Engineering—A Profession or a Trade." Col. Leroy F. Grant, field secretary, The Engineering Institute of Canada, presided, and J. Calvin Brown introduced Mr. McNab. A. C. Pasini, vice-president, ASME Region V, moved the vote of thanks.

The Banquet

The banquet on Wednesday evening was preceded by a reception. Guests at the head table were "piped in" by Pipe Major Fraser. President Brown presided. Toasts to His Majesty the King and to the President of the United States were followed by the singing of one verse each of "God Save the King" and "America." The invocation was pronounced by Carl J. Eckhardt, vice-president, ASME Region VIII. While the meal was being served, vocal selections were rendered by a quartette, "The Four Gentlemen."

At the conclusion of the meal President Brown presented a fifty-year ASME emblem to Robert W. Angus, Honorary Member and former vice-president ASME, professor-emeritus of mechanical engineering, University of Toronto. A certificate of Fellow grade of ASME membership was presented to Vincent V. Veenschoten of Erie, Pa.

Norris R. Crump Honored

Honorary membership in ASME was conferred on Norris R. Crump, vice-president, Canadian Pacific Railway Company. Mr. Crump was presented to the president by Warner Seely, member of the ASME Board on Honors. Mr. Crump, who was born in Revelstoke, British Columbia, Canada, in 1904, began his railroad career in 1920 after graduation from high school. After completion of his apprenticeship he entered Purdue University which awarded him the degree of BS in ME in 1929, and the degree of ME in 1936. Mr. Crump's rise in the Canadian Pacific Railway Company, to which he returned after graduation, has been continuous and rapid. In May, 1949, he became vice-president, a director, and a member of the executive committee of the CPR. He holds many other directorships, was awarded the honorary degree of doctor of laws by Queen's University in 1950, and is a member of The Engineering Institute of Canada. As chief operating officer of CPR, he maintains a keen interest in the industrial and economic development of Canada. He is a member of the Executive Council of the Canadian Chamber of Commerce, the Dollar-Sterling Advisory Council, and the Montreal Board of Trade. The citation which accompanied the certificate of Honorary Membership reads: "Distinguished engineer, eminent executive, so endowed with the cardinal virtues of life that he rose from a humble beginning to a position of high prominence in Canada. He is one of his country's foremost citizens and an inspiration to young engineers in all lands."

NORRIS R. CRUMP, VICE-PRESIDENT, CANADIAN PACIFIC RAILWAY COMPANY, ON WHOM HONORARY MEMBERSHIP IN ASME WAS CONFERRED AT TORONTO

C. D. Howe Addresses Banquet

The banquet address was delivered by the Right Honorable C. D. Howe, Honorary Member ASME, Minister of the Department of Defense Production of the Government of Canada. The address, "Canada's Industrial Potential," will be found in this issue. E. G. Bailey, past-president ASME, moved the vote of thanks.

Nomination for ASME Officers for 1952

At the banquet C. E. Davies, secretary ASME, made public the report of the Nominating Committee for 1952 officers, as follows: For president, R. J. S. Pigott, Fellow ASME, chief engineer, Gulf Research and Development Company, Pittsburgh, Pa.; for vice-presidents: Region I, Willis F. Thompson, vice-president and chief mechanical engineer, Westcott and Mapes, Inc., New Haven, Conn.; Region III, Ernest Henry Hanhart, consulting mechanical engineer, Baltimore, Md.; Region V, Ernest Stephan Theiss, assistant chief engineer, Davey Compressor Company, Kent, Ohio; Region VII, Samuel H. Graf, Fellow ASME, director, Engineering Experiment Station, Oregon State College, Corvallis, Ore. (renomination); Directors at Large: A. C. Pasini, superintendent of production, The Detroit Edison Company, Detroit, Mich., and Paul B. Eaton, head, mechanical-engineering department, Lafayette College, Easton,

AT THE BANQUET HEAD TABLE

(*Left to right:* Mrs. James M. Todd; E. G. Bailey, past-president ASME; Ira P. Macnab, president EIC; Mrs. Norris R. Crump; the Right Honorable C. D. Howe; J. Calvin Brown, president ASME; Norris R. Crump, Honorary Member ASME.)

Pa. Brief biographies of the nominees will be found in this issue.

Technical Program

The technical portion of the program of the 1951 Semi-Annual Meeting began on Monday morning and ran through Thursday. Thirty-five sessions were scheduled at which 78 papers were presented, including three sessions sponsored by the American Rocket Society, affiliated with ASME.

Almost every ASME professional division and several committees sponsored, either alone or jointly with other groups, one or more technical sessions. Papers by Canadian engineers relating to Canadian projects were prominently featured in the program. The Gas Turbine Power Division co-operated in nine sessions. Seven of these were co-sponsored by the Aviation Division and in three the Institute of the Aeronautical Sciences and the Society of Automotive Engineers (Canadian Section) participated. Papers at these sessions were devoted to the Avro *Jetliner*, the *Apollo*, the *Comet*, and the *Princess* aircraft; and to the Mamba engine. Abstracts of most technical papers have appeared or will appear in MECHANICAL ENGINEERING.

A Junior Conference, under the auspices of the Joint Committee, was held Monday evening. Carey H. Brown, manager, engineering and manufacturing services, Kodak Park Works, Eastman Kodak Company, Rochester, N. Y., and chairman, Engineering Manpower Commission of the Engineers Joint Council, addressed the conference on the subject, "A Current Plan for Young Engineers." A dozen Junior members from nearby sections in Region V were in attendance as guests of the ASME Old Guard.

Society Affairs Discussed

The Council of The American Society of Mechanical Engineers was held on Sunday and Monday. Actions of interest to members will be found on page 691 of this issue. On Monday the Council received a summary report of the Regional Delegates Conference which convened for its first session on Sunday morning. (See page 690.)

Under an agreement between The Engineering Institute of Canada and The American Society of Mechanical Engineers, an ASME-EIC Joint Conference Committee was set up in 1943. This Committee met at Toronto on Thursday and approved a final version of a new draft of the agreement. The Committee is made up of four representatives of each Society. ASME representatives are A. G. Christie, chairman, A. C. Pasini, T. E. Purcell, and H. G. Thompson. EIC is represented by O. W. Ellis, J. G. Hall, G. N. Martin, and W. A. Newman. The presidents and secretaries of both societies attended the Toronto meeting of the Committee.

A business meeting of ASME was held on Monday afternoon, just before a welcoming reception made possible through the courtesy of about 70 Canadian industrial firms. An account of the Business Meeting will be found on page 690.

Throughout the entire meeting many Society committees got together for the discussion of their problems. The vice-presidents

THE RIGHT HONORABLE C. D. HOWE DELIVERS THE BANQUET ADDRESS

of the Society who were present met on Tuesday morning.

Canadian Industries Visited

The technical program at Toronto was arranged to leave Tuesday afternoon free for inspection trips to some of the industrial plants of the neighborhood.

A. V. Roe Canada Limited demonstrated the Avro *Jetliner* and two Avro CF100 all-weather day-night fighters, and showed visitors the Orenda-Lancaster engine test laboratory.

MacLean-Hunter Publishing Company offered the engineers an opportunity to inspect their modern building and its equipment and processes.

The Massey-Harris Company, producers of agricultural machinery, opened their plant for the inspection of modern production-line assembly of farm combines.

Christie-Brown Biscuit Bakery showed its new 4½-acre building including 200-ft propane-fired ribbon ovens.

Also available for inspection were the laboratories of the Ontario Research Foundation and the new Mechanical Building of the University of Toronto.

Women Visitors Entertained

On Monday, the women visitors at the meeting joined in the President's Luncheon and the Welcoming Reception. On Tuesday morning the women visited the Christie-Brown Biscuit Bakery and left from there to attend a luncheon at "The Old Mill," where they were addressed by Kate Aitken, noted world traveler. A tour of the University of Toronto, Queen's Park, the Royal Ontario Museum, and Casa Loma ended at Eaton's Round Room, where luncheon was served on Wednesday. The program for Thursday included a luncheon at the Royal Canadian Yacht Club on Toronto Island.

Local Committees Insure Success

Too much credit cannot be given to the work of the Toronto General Committee and its subcommittees which carried on the burden of planning and administration of the meeting in Toronto and were in constant attendance to insure its successful operation and the comfort of their guests. The personnel of the General Committee was as follows: Fred Truman, chairman; H. G. Thompson, vice-chairman; W. R. Trusler, secretary; C. R. Davis; D. W. Knowles.

G. A. S.

AT THE EIC-ASME JOINT LUNCHEON

(*Left to right:* C. E. Davies, secretary ASME; Ira P. Macnab, president, EIC; Leroy F. Grant, field secretary, EIC; J. Calvin Brown, president ASME.)

EIC-ASME JOINT CONFERENCE COMMITTEE MEETS AT TORONTO

(*Seated, left to right:* O. W. Ellis, H. G. Thompson, J. G. Hall, Ira P. Macnab, A. G. Christie, J. Calvin Brown, C. E. Davies, R. J. S. Pigott, A. C. Pasini. *Standing:* S. H. Graf, L. Austin Wright, Ernest Hartford.)

R. J. S. Pigott

Nominated for President

ASME OFFICERS *Nominated for* 1951—1952

DURING the Meeting of The American Society of Mechanical Engineers in Toronto, Ont., Can., June 11–15, 1951, R. J. S. Pigott, chief engineer, Gulf Research and Development Company, Pittsburgh, Pa., was nominated by the National Nominating Committee for the office of President of the Society for the year 1951–1952.

Regional Vice-Presidents named by the Committee to serve two-year terms on the Council of the ASME were Willis Frederick Thompson, New Haven, Conn.; Ernest Henry Hanhart, Baltimore, Md.; Ernest Stephen Theiss, Kent, Ohio; and Samuel H. Graf, Corvallis, Ore.

Directors at Large named by the Committee to serve a four-year term on the Council were Albert Carl Pasini, Detroit, Mich., and Paul B. Eaton, Easton, Pa.

Members of the Committee making the nominations were A. J. Ferretti, Boston, Mass., representing Region I; P. T. Onderdonk, secretary, New York, N. Y., representing Region II; W. G. McLean, Easton, Pa., representing Region III; J. A. Keene, Birmingham, Ala., representing Region IV; F. F. Borries, Cincinnati, Ohio, representing Region V; H. A. Bolz, Lafayette, Ind., representing Region VI; W. A. Pearl, Pullman, Wash., representing Region VII; and V. L. Doughtie, chairman, Austin, Texas, representing Region VIII.

Election of ASME officers for 1951–1952 will be held by letter ballot of the entire membership, closing September 25, 1951.

Biographical sketches of the nominees follow on the succeeding pages.

ASME NEWS

Nominated for President

R. J. S. Pigott

REGINALD JAMES SEYMOUR PIGOTT, who has been nominated to serve for one year as President of The American Society of Mechanical Engineers, has been since December, 1929, the chief engineer, director of engineering division, Gulf Research and Development Company, in charge of engineering research. He was born Feb. 4, 1886, at Wellington, Shropshire, England, and received his early education in the public schools of New York, N. Y. He was graduated from DeWitt Clinton High School in 1902 and from Columbia University, with an ME degree, in 1906. In 1946 Columbia presented him with the Columbia University Medal for engineering achievements.

His previous experience includes eleven years in the design, construction, and operation of central steam-power stations, seven years in designing and constructing industrial plants, and five years in the manufacture of metal products.

His professional record includes more than 30 patents on devices in the power-station and oil-production fields. His specialties are: Power plant design; design of power apparatus; design of products; valves and instruments; design of combustion apparatus, both power and industrial; fluid flow; pumps; lubrication; and internal-combustion prime movers.

Mr. Pigott taught at Columbia University as professor of steam engineering, 1912–1913. He has served as chief draftsman, assistant engineer, and consulting engineer for Interborough Rapid Transit Company; as superintendent of construction for New England Engineering Company; as consulting engineer or manager for Remington Arms-Union Metallic Cartridge Company, Crosby Steam Gage and Valve Company, Gradon Manufacturing Company, Stevens and Wood, Inc., and other firms. Some of his other noteworthy accomplishments are the smoke-abatement plan for Bridgeport, Conn.; standardization of oils and cutting compounds for Remington Arms; introduction of new designs in safety valves and steam gages for Crosby; tube-mill improvement for Bridgeport Brass; design of lightweight one-man streetcar with independently sprung wheels; and codification of stoker design.

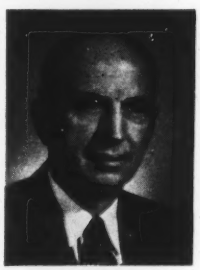
Mr. Pigott joined the Society in 1912 and has been a Fellow ASME since 1938. He has served the Society as chairman of the Special Research Committee on Fluid Meters from 1916 to 1946 and was responsible for starting this committee; as member of the main Power Test Codes Committee; and as chairman of the Definitions and Values Committee from 1918 to 1946; as Vice-president of the ASME, 1936–1938.

He is past-president of the Society of Automotive Engineers, the only oil man to hold this office, past-president of the American Society for Measurement and Control, now the Pittsburgh Chapter of the Instrument Society of America; and he was president of the Instrument Society of America for 1950.

He is the author of about 40 technical papers on power-plant design, fluid flow, instruments, lubrication, superchargers, and so on. He is a member of Tau Beta Pi, Sigma Tau, Sigma Xi, and Pi Tau Sigma.

Nominated for Regional Vice-Presidents

To Serve Two-Year Term



W. F. THOMPSON

E. H. HANHART

Willis F. Thompson

WILLIS F. THOMPSON, who has been nominated from Region I to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Woodbridge, Conn., Dec. 11, 1895. He was graduated from New Haven High School and attended Yale University as a special student in mechanical engineering.

He has been associated with Westcott and Mapes, Inc., architects and engineers, New Haven, Conn., since 1916, beginning his work as chief draftsman and later filling the positions of mechanical engineer and chief mechanical engineer. In 1929 he was elected a director and assistant secretary of Westcott and Mapes and in 1946 became vice-president, which position he now holds.

He was with the Ordnance Department, U. S. Army, from 1917 through 1919, designing and constructing steam-electric generating plants for government-owned arsenals and armories. During World War II he was a member of the Connecticut State Guard.

Mr. Thompson became a member of ASME in 1919 and has always taken an active part in local, state, and national affairs of the Society. He is a past-chairman of the New Haven Section and has been a member of the General Committee of Connecticut sections and of the Connecticut Section Committee for the 1949 National Spring Meeting held in New London, Conn. From 1947 to 1949 he was an ASME delegate to the Connecticut Technical Council and during this time was chairman of their Student Guidance Committee which was active in its contacts with students in the various high schools throughout the State. He has also been a delegate to the Regional Administrative Conference of ASME. His participation in national activities of ASME include: Member, Nominating Committee, Power Show Advisory Committee, and Membership Development Committee. He is a member of the Power Piping Code Committee, the Meetings Committee of ASME, and chairman, National Guidance Committee of the Engineers Council for Professional Development.

He is licensed to practice engineering in the states of Connecticut, Massachusetts, and New York. He is a member of the Connecticut and National Societies of Professional Engineers. His memberships in other organizations are: New Haven Kiwanis Club, of which he is a past vice-president; New Haven Chamber of Commerce, of which he is a director; New Haven Commandery #2, K.T.; American Legion, Woodbridge (Conn.) School Board; Woodbridge Republician Town Committee; Zoning Board of Appeals; Woodbridge Club; Engineers' Club, New York, N. Y., and Quinnipiack Club, New Haven.

Ernest H. Hanhart

ERNEST H. HANHART, who has been nominated from Region III to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Weehawken Heights, N. J., March 23, 1910.

He received his engineering education at The Johns Hopkins University, Baltimore, Md., where he was graduated in 1933, with a BE degree. After graduation he was employed by the Bethlehem Steel Company at the Sparrows Point, Md., plant, where he worked at a variety of basic engineering occupations before serving in a direct engineering capacity.

In 1936 he was made general field foreman in charge of the maintenance, rebuilding, and construction of blast furnaces and coke ovens.

He was responsible for the development of many steel-plant mechanical methods and devised numerous devices and techniques related to blast-furnace and coke-oven construction.

Upon promotion to division engineer in 1940 he served as a liaison during the design and manufacture of a continuous butt-weld pipe mill, initiating many design features in the engineering development of the mill. During World War II, with the Bethlehem Steel Company, he established several world records in the rebuilding of blast furnaces and coke ovens, accomplished by methods of construction and scheduling which hitherto were considered impracticable. In 1943, in addition to his other duties, he was given the position of development engineer, responsible for the analysis and solutions of numerous problems peculiar to the steel industry. His outstanding contribution in this direction was the establishment of proof that a blast furnace produces fresh water during its operation, which water may be drained.

In 1945 he entered the consultant field and shortly afterward was engaged in the design and fabrication of a portable hydrogen liquefier for the U. S. Navy. The result of this endeavor produced a liquefier not requiring the direct use of a compressor, and which could be operated both in the field and in aircraft. Since his entry into the consultant field he has been engaged in a wide variety of mechanical-engineering problems involving fundamental investigation. He has several developments which are in process of investigation for patent issue. For the past few years he has been active in the development and experimental engineering application of a new liquid high-temperature refractory binder.

Mr. Hanhart joined the Society in 1933 and is an active worker in the Baltimore Section. In 1947–1948 he served as chairman of the Baltimore Section and in 1949 was appointed to serve for two years as secretary of Region III. He is a member of several committees related to civic affairs and has membership in the Engineers Club of Baltimore, for which he has served on the board of directors as the ASME affiliate director. For the past five years he has been on the faculty of the McCoy College of Engineering, The Johns Hopkins University.

Ernest Stephen Theiss

ERNEST STEPHEN THEISS, who has been nominated from Region V to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers was born in Detroit, Mich., May 16, 1910.

He received his engineering education at Case School of Applied Science, Cleveland, Ohio, where he was graduated in 1932 with a BSME degree; in 1939 he received an MSME from Case. From 1932 to 1934 he was employed by the Goodyear Service, Inc., in Cleveland, Ohio. Then for three years he was with the Goodyear Tire and Rubber Company as a development engineer. In 1937

E. S. THEISS

he went to Case School of Applied Science as a graduate assistant where he remained for two years. From 1939 to 1946 he was engaged in the mechanical-engineering profession; at first as an instructor and later as an assistant professor at Duke University, Durham, N. C. In 1946 he joined Davey Compressor Company, Kent, Ohio, as assistant chief engineer and since Jan. 1, 1951, he has been chief engineer of this company. He is a registered engineer in the State of Ohio.

Mr. Theiss is the coauthor of "Design Manual," first edition, Goodyear Aircraft Corporation, 1942, and six manuals on air compressors for Wright-Patterson Air Force Base, Dayton, Ohio.

He became a member of the ASME in 1939 and has served the Society as vice-chairman, Raleigh Section (now East Carolina), 1944–1945, and chairman, 1945–1946; secretary-treasurer, Akron-Canton Section, 1949–1950, and chairman, 1950–1951. In 1945 he was delegate to the Region IV Administrative Committee and junior delegate of Region IV to the Regional Delegates Conference. From 1945 to 1946 he was secretary of Region IV. In 1951 he was a member of the Region V Administrative Committee. He is a member of the board of directors, Kiwanis Club, Kent, Ohio, and Phi Kappa Sigma Fraternity. He is also a member of the honorary fraternities, Pi Tau Sigma and Delta Epsilon Sigma.

Samuel H. Graf

SAMUEL H. GRAF, who has been renominated from Region VII to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Portland, Ore., Aug. 4, 1887. He received his BS in EE in 1907, EE in 1908, BS in ME, 1908, ME in 1909, and MS in EE in 1909, all from Oregon State College.

Since 1908 Professor Graf has been connected with Oregon State College. He started as an assistant in the mechanical-engineering department. After several years as instructor and assistant professor in mechanical and experimental engineering, he was appointed head of the department of experimental engineering in 1912, and two years later, professor. From 1920 to 1934 he served as professor of mechanics and materials. He has also been director of engineering research,

S. H. GRAF

1927 to 1944, and director of the Engineering Experiment Station, 1944 to the present. From 1934 to 1950 he was professor of mechanical engineering and head of the department.

Professor Graf has had an active consulting practice, serving as research engineer for about four years with the Portland Gas and Coke Company, in research work in safety of appliances for the American Gas Association Testing Laboratory, and as research engineer with the Iron Fireman Manufacturing Company. He was consulting engineer from 1935 to 1937 for the Bonneville Power and Navigation Project, and has been a consulting engineer for the Corps of Engineers, U. S. Army, on the Willamette Valley Project since 1936. He spent one summer conducting comprehensive tests on four suction dredges operated by Port of Portland and was test engineer in 16 trial trips of merchant vessels built in Portland, Ore. He was a test engineer with the U. S. Shipping Board, Portland, Ore., for one year.

Professor Graf served as a member of the State Board of Engineering Examiners, 1927 to 1949, representing the field of mechanical engineering, and as president of the Board, 1939 to 1949. He was director of the western zone of the National Council of State Boards of Engineering Examiners from 1934 to 1936. In 1936–1937 he was vice-president and in 1937–1938 he served as president of NCSBEE.

In addition to his many outside engineering connections he has worked on many and various problems in the testing and research laboratories at Oregon State College. These investigations and tests have included work on structural materials, highway materials, fuels, and lubricants. He has also been engaged as consultant on inventions and a wide variety of problems brought to the college for solution.

As faculty editor of *Oregon State Technical Record* since the start of that publication Professor Graf has contributed many semitechnical articles to its pages. He was coauthor of the Gas Appliance Testing Code published by Pacific Gas Association, and editor of the "Gas Engineers' Handbook," a reference work of about 1000 pages published in 1934 by McGraw-Hill Book Company, Inc., New York, N. Y.

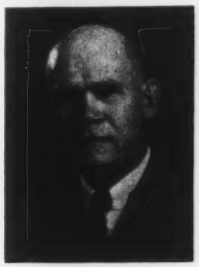
Professor Graf joined the Society in 1912 and is a past-chairman of the Oregon Section of the ASME, past vice-president of the North-

western Society of Highway Engineers, past-president of the Oregon Chapter of the American Society for Metals, and a member of the Pacific Coast Gas Association. He has served twice on the Nominating Committee of the ASME, and has been honorary chairman of the ASME student branch at Oregon State College. He was manager of the ASME, 1943–1945, and director at large, 1945–1946, and is currently Vice-President for Region VII. He is a registered professional engineer of Oregon and a past-president of Corvallis Engineers Club. He belongs to the honorary fraternities Tau Beta Pi, Sigma Tau, Pi Tau Sigma, Eta Kappa Nu, Sigma Xi, Sigma Pi Sigma, and Phi Kappa Phi.

Nominated for Directors at Large

To Serve Four-Year Terms

A. C. PASINI



P. B. EATON

Albert Carl Pasini

ALBERT CARL PASINI, who has been nominated to serve as Director at Large of The American Society of Mechanical Engineers for a four-year term, was born in Paterson, N. J., Feb. 9, 1900. He received his earlier eduction in Providence, R. I., where he served as a machinist's apprentice with the Builders Iron Foundry. In 1923 he received his BS degree in mechanical engineering from the University of Michigan. He is employed by The Detroit Edison Company. At present he is superintendent of the Connors Creek Station and recently was given added duties as superintendent of the new St. Clair Station which is now being erected.

Mr. Pasini has served in the Engineering Society of Detroit on numerous committees and has been chairman of the affiliate council which is the co-ordinating agency for 35 societies and 25,000 engineers in the Detroit area. He has been active in civic affairs as related to the Engineering Society of Detroit.

He has also served on several subcommittees of the Edison Electric Institute. During World War II he was fuel engineer on the fuel-efficiency council in the Solid Fuels Administration.

He joined the ASME in 1931. He has served as chairman, secretary, treasurer, and program-committee chairman of the Detroit Section.

He has also served the ASME as chairman of the National Agenda Committee and as chairman of the National Membership Development Committee, and has also been a member of the Board on Membership. At present he is Vice-president of Region V of the ASME.

Mr. Pasini is the author of several papers which have been published in the Transactions of the ASME. He has also published articles in various technical journals. He lives in Detroit and is a registered professional engineer of Michigan. He is a member of Theta Chi Fraternity and an honorary member of Pi Tau Sigma, the honorary mechanical engineers' fraternity.

Paul B. Eaton

PAUL BURNS EATON, consulting engineer, and professor and head of the mechanical-engineering department of Lafayette College, who is a nominee for a four-year term as Director at Large of The American Society of Mechanical Engineers, was born in Scranton, Pa., in 1888. He was graduated from Sibley College, Cornell University, 1911, with the degree of mechanical engineer.

From 1911 to 1914 and then from 1920 to 1922, he was an instructor in machine design at Cornell University. In 1914 he accepted a position as head of the department of mechanical engineering at the Chinese Government Engineering College at Tangshan. For his services he was decorated with the Order of the Chia Ho by the Government of the Republic of China. Upon the entrance of the United States into World War I he returned to this country and was assigned as an engineer to the technical department of the U. S. Shipping Board, Middle Atlantic District, Baltimore, Md. Upon being relieved from this position he went back to Cornell University. In 1923 he accepted a position as assistant professor of mechanical engineering at the Pennsylvania State College, and in 1924 went to Lafayette College as an associate professor of mechanical engineering. In 1931 he was promoted to the rank of professor and also became head of the department. In 1943–1944 he was sent on a special mission to the Government of the Republic of China by the U. S. Department of State to maintain China's industries in the war effort. Subsequently he headed the Technical Orientation Division of the International Training Administration, Washington, D. C., carrying out details arranged during his mission to China.

Professor Eaton has been a member of the ASME since 1922 and a Fellow ASME since 1949, has served as chairman of the Anthracite-Lehigh Valley Section, was elected delegate to the Local Sections Conferences in 1937 and 1938, serving as speaker at the latter one; manager of the Society, 1940–1942; and Vice-president of the Society, Region III, 1947–1949.

He also holds membership in the American Society for Engineering Education, American Association of University Professors, Tau Beta Pi, Pi Tau Sigma, Engineers' Club of the Lehigh Valley (past-president), Newcomen Society of England, Theta Xi, Kiwanis, and numerous local, civic groups in his home community.

He is the author of several papers and articles of technological nature as well as those dealing with our relations with the Far East.

Professor Eaton devotes his spare time lecturing to explain the aims, ideals, and purposes of the leaders of Asia in their efforts to elevate the standard of living of the teeming mass of humanity depending upon them.

The Conference at The Hague

THE American Society of Mechanical Engineers will be one of the EJC Societies represented at the Conference of the Engineering Societies of Western Europe and the United States to be held at The Hague, The Netherlands, Sept. 17–21, 1951.

The Engineers Joint Council will also be represented by a member of the American Society of Civil Engineers, and the American Institute of Electrical Engineers.

The Institute of Mining and Metallurgical Engineers and the Institute of Chemical Engineers recently gave their consent to the presentation of their names as possible members of the conference.

Previous conferences worked to improve international relations among engineers by agreeing on arrangements for visiting lecturers, courtesies to visiting members of other participating societies, visits by parties of students, and relations with UNESCO. Another subject to which the conference has given considerable attention is the co-ordination and extension of abstract services.

In addition to the United States other countries to be represented are: Belgium, Denmark, Finland, France, Holland, Norway, Sweden, Switzerland, and the United Kingdom.

ASME Regional Delegates Favor EJC Unity Plan "A"

THE ENGINEERS Joint Council was unanimously favored as a basis for a unity organization of the engineering profession by Regional Delegates of The American Society of Mechanical Engineers, at a conference held in Toronto, Ont., during the Semi-Annual Meeting of the Society.

After considering the four plans offered as a basis for discussion by the Exploratory Group to Consider the Increased Unity of the Engineering Profession, regional delegates unanimously accepted a resolution which favored a modification of Plan A, the "EJC Plan."

The resolution on unity follows:

Be it resolved that it is the consensus of the Regional Delegates Conference that:

1 Greater unity is desirable in furthering the interests of the engineering profession.

2 Greater unity can best be accomplished by continuing and extending the activities of the Engineers Joint Council.

3 Unity organizations of the council type should be organized at the local level. (Area to be determined by the needs of the sections and by political subdivisions.)

4 A direct channel of communication between the national unity organization and the local unity organizations should be established and between the local organizations and the sections of the participating societies.

5 All members of the national unity organization should be members of the participating societies.

6 Financial support of the national and local unity organizations should come from the national organizations of the participating societies.

7 The attached diagram of organization should fullfill the requirements outlined above.

Regional delegates conferences are held annually during the semi-annual meetings of the Society and are composed of two delegates from each of the ASME eight regions. The conferences discuss agenda covering any aspect of Society operation proposed by any Section and approved by at least 15 other Sections. Agenda items are taken up first by the Regional Administrative Committees and finally by the Regional Delegates Conference whose recommendations are presented to Council for reference to appropriate boards and committees for further study or action.

E. J. Kates Addresses Delegates

Before taking up the unity question, the delegates heard from Edgar J. Kates, ASME member of the Exploratory Group. Mr. Kates stressed that the "four plans" were not recommendations of the Exploratory Group, but were merely the four principal schemes around which most of the discussion on unity appeared to center. The four plans, he said, were intended as a basis of discussion and he asked for an expression of views to guide him in future discussions of the Exploratory Group, the next meeting of which is planned for early fall.

According to Paul T. Onderdonk, secretary of the conference, at no time was there any doubt about the desire of delegates to see an expansion of the EJC into an over-all unity organization. While the ASME resolution does not provide for individual membership in the unity organization, delegates were not opposed to such membership, Mr. Onderdonk said. It was the consensus that this feature could be provided later after the expanded unity organization was established. Since national engineering societies would be the only sources of operating funds in the early stages of organization, the delegates emphasized the role of national societies. There was a strong feeling that the value of individual membership lay in the sense of individual participation that such membership tends to convey. By providing for unity organizations of the council type on the local level, the modified Plan "A," the delegates believed, creates an opportunity for individual participation on the local level by engineers in all sections of the country. Such widespread participation, it was felt, would sustain the unity idea far better than activities on the national level where opportunities for the individual to serve are much more limited.

Agenda of 28 Items

The delegates expressed themselves on some 28 items, many of which they rejected. While they approved the recommendation to waive the requirement of a minimum of 50 members to form a sub-section and that headquarters should notify section officers when a member of the Section was elevated to the grade of Fellow, the delegates rejected such items as (1) to liberalize allocation of funds to Sections; (2) to allow Sections to print letterheads locally; (3) to establish regional nominating committees; (4) to change the term of Vice-president from two years to one year; (5) to reduce the initiation fee; and many other details important to the administration of a large national organization.

Publications

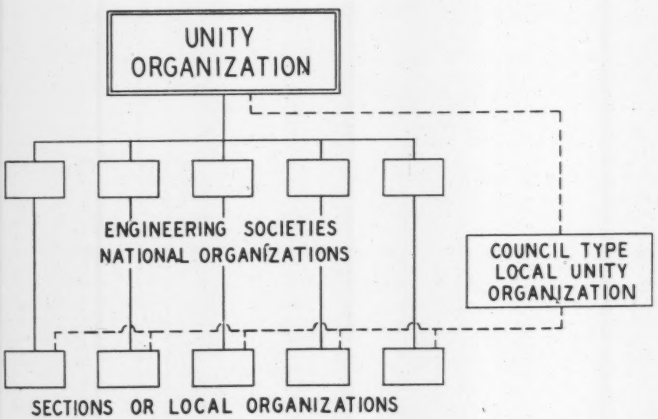
A motion to recommend reduction of the cost of Transactions to members was rejected. Since subscriptions to Transactions and the *Journal of Applied Mechanics* do not cover cost of publication, the delegates felt the Society should not increase its subsidy at this time.

Also rejected were several items calling for more attention by the ASME to the economic interests of its members, and the initiation of a project for collecting comparable data on salaries of the various learned professions.

Business Meeting Approves Proposed Amendments for Letter Ballot

TWO proposed amendments to the constitution of The American Society of Mechanical Engineers were approved for submission to a vote of the membership at the ASME Semi-Annual Business Meeting held recently in Toronto, Ontario, Canada. The amendments provide for indemnification of Society officers in actions arising from performance of their duties and for appointment of one or more assistant secretaries and treasurers.

The indemnification clause is proposed as Article C6, Section 6. It states: "Each person (his heirs, executors and administrators) shall be indemnified by the Society against expenses reasonably incurred by him in connection with any action, suit, or proceeding to which he may be made a party by reason of his serving or having served as a member of the Council or member of a board or a committee or an officer or employee of the Society, or of another corporation or organization with which he may serve or have served as such or



SKETCH OF THE MODIFIED EJC PLAN "A" FAVORED BY THE ASME REGIONAL DELEGATES AT SEMI-ANNUAL MEETING IN TORONTO

as a trustee, at the request of the Society, or by reason of his otherwise serving or having served as a nominee of the Society, except in relation to matters as to which he shall be finally adjudged in such action, suit, or proceeding to be liable for negligence or misconduct in the performance of his duties. Such expenses shall include the cost of reasonable settlement made with a view of curtailment of litigation. The foregoing right of indemnification shall not be exclusive of other rights to which he may be entitled as a matter of law."

The second amendment is to Article C8, Section 2 and supplements the clause with the following sentence: "At its first meeting the Council shall appoint members of the Society to serve as secretary and as treasurer for one year."

A nominating committee for 1952 selected by ASME Regions was confirmed. For names and addresses of members, see page 686 of this issue.

ASME 1952 Nominating Committee Organizes

SELECTED at the 1951 Semi-Annual Business Meeting of The American Society of Mechanical Engineers, Toronto, Ontario, Can., June 11, 1951, the 1952 National Nominating Committee at its organization meeting, chose J. A. Keene, Alabama Power Company, 600 North 18th St., Birmingham 2, Ala., as chairman, and C. R. Davis, Davis Automatic Controls, Ltd., 4251 Dundas St., W., Toronto 18, Ontario, Can., as secretary.

Plans were made for a preliminary meeting of the committee at the 1951 Annual Meeting, Atlantic City, N. J., at which arrangements will be made as to time and location of the executive meeting for nomination of the Society Officers in 1952.

The 1952 National Nominating Committee is composed of the following:

REGION I. William P. Saunier, Jackson and Moreland, Park Square Building, 31 St. James Ave., Boston 16, Mass.; Raymond H. Tolman, *1st Alternate*, Bay State Abrasive Products Company, West Main, Westboro, Mass.; Harry E. Harris, *2nd Alternate*, 229 Thorme St., Bridgeport 6, Conn.

REGION II. Kenneth J. Moser, Stevens Institute of Technology, Hudson St., Hoboken, N. J.; William H. Bryne, *1st Alternate*, Byrne Associates, Inc., 140 Nassau St., New York 7, N. Y.; W. S. Johnston, *2nd Alternate*, Sanderson and Porter, 52 William St., New York 5, N. Y.

REGION III. Charles C. Di Ilio, mechanical-engineering department, The Pennsylvania State College, State College, Pa.; Charles R. Otto, *1st Alternate*, engineering materials department, Cornell University, Ithaca, N. Y.; W. N. Richards, *2nd Alternate*, International Correspondence Schools, 1001 Wyoming Ave., Scranton 9, Pa.

REGION IV. J. A. Keene, *chairman*, Alabama Power Company, 600 North 18th St., Birmingham 2, Ala.; E. M. Williams, *1st Alternate*, Clinchfield Fuel Company, Box 410, Spartanburg, S. C.; R. C. Robertson, *2nd Alternate*, mechanical-engineering department, University of Tennessee, Knoxville 16, Tenn.

REGION V. C. R. Davis, *secretary*, Davis Automatic Controls, Ltd., 4251 Dundas St., W., Toronto, 18, Ont., Can.; Henry S. Walker, *1st Alternate*, The Detroit Edison Company, 2000—2nd Ave., Detroit 26, Mich.; E. W. Allardt, *2nd Alternate*, Welded Tube Division, Babcock & Wilcox Co., Alliance, Ohio.

REGION VI. Robert T. Mees, research department, Caterpillar Tractor Company, Peoria 8, Ill.; Robert E. Gallatin, *1st Alternate*, 4132 Warsaw St., Fort Wayne 5, Ind.; R. S. Stover, *2nd Alternate*, R. S. Stover Company, 212 Kresge Building, Marshalltown, Iowa.

REGION VII. F. B. Lee, Fairman B. Lee Company, 219 Central Building, Seattle 4, Wash.; A. R. Weigel, *1st Alternate*, Consolidated Western Steel Corp., 5700 S. Eastern Ave., Los Angeles 54, Calif.; S. T. Johnson, *2nd Alternate*, American Smelting and Refining Company, Garfield, Utah.

REGION VIII. Arnold R. Mozisek, Dallas Power and Light Company, 1506 Commerce Street, Dallas 1, Texas; Robert P. Lockett, *1st Alternate*, A. M. Lockett and Company, 308 Whitney Building, New Orleans, La.; Carl A. Stevens, *2nd Alternate*, Oklahoma Institute of Technology, Oklahoma A. & M. College, Stillwater, Okla.

Actions of the ASME Council

At a Meeting in Toronto, Ontario, Canada, June 10–11

THE Council of The American Society of Mechanical Engineers met in five sessions during the Semi-Annual Meeting of the Society in the Royal York Hotel, Toronto, Ontario, Canada. There were present: President, J. Calvin Brown; past-presidents, E. G. Bailey, J. D. Cunningham, E. W. O'Brien, J. M. Todd; vice-presidents, C. J. Eckhardt, S. H. Graf, F. M. Gunby, H. R. Kessler, S. D. Moxley, A. C. Pasini, J. C. Reed, Forrest Nagler representing J. T. Rettaliata; directors at large, L. J. Cucullu, B. P. Graves, J. A. Keeth, H. E. Martin, A. L. Penniman, Jr., W. M. Sheehan, R. A. Sherman; assistant treasurer, E. J. Kates; secretary, C. E. Davies; Board on Education and Professional Status, G. R. Cowing; Constitution and By-Laws Committee, K. P. Hanson; Regional delegates, *Region I*, A. C. Crownfield, P. A. Nims; *Region II*, P. T. Onderdonk, A. T. Kniffen; *Region III*, S. B. Sexton, W. J. Kinderman; *Region IV*, Bruce Sherrill, P. C. Capps; *Region V*, Thompson Chandler, C. C. Womack, Sr.; *Region VI*, L. S. Whitson, D. B. Naulin; *Region VII*, F. P. Baeyertz, S. T. Johnson, R. L. Iglehart; *Region VIII*, W. H. Parks, B. B. Brainard; 1951 Agenda Committee, W. H. Bryne, E. H. Walton; EJC Engineering Manpower Commission, Carey H. Brown, chairman; junior observers, W. P. Wier, Jr., J. R. Davidson, D. L. Lynch, and David Cronberger.

National Management Council

Following a discussion of a request from the National Management Council for an increase in contribution to its support by the ASME, it was voted to continue the Society's contribution at the present rate of $500 per year.

Constitution and By-Laws

Two amendments to the Constitution concerning indemnification of Society officers and the appointment of assistant secretaries and treasurers were approved for submission to the Business Meeting. (See page 690 of this issue.)

An amendment to Article B6A, Paragraph 15 was adopted. The amendment clarifies the function of the Board on Codes and Standards and recognizes the new status of the Safety Committee as the Safety Division of the Society. Paragraph 15B was deleted and Paragraph 15C was renumbered 15B and Paragraph 15D was renumbered 15C.

The following proposed By-Laws amendments received their first reading: Article B6, Paragraph 2, which is amended to read "Throughout his term of office each vice-president shall reside or have his principal place of business in the Region which he represents."

Proposed amendments to Article B6A, Paragraph 1, Paragraph 11, and Article B8, Paragraph 4 recognize either the assistant secretary and the assistant treasurer or both as officers of the Society.

Proposed Amendment to Article B8, Paragraph 5 reads as follows: "The Treasurer shall be the legal custodian of all funds of the Society." It deletes the sentence "The investment of all trust funds and of other permanent or temporary investment of funds shall be made by the Treasurer with the approval of the Finance Committee and the Council."

Proposed amendment B8, Paragraph 6, reads "in the absence of the Treasurer his duties shall be performed by an assistant treasurer."

A new paragraph known as Paragraph 9 was proposed for Article 8. This reads "In the absence of the secretary his duties shall be performed by the assistant secretary." It was proposed to renumber the old Paragraph 9 as Paragraph 10.

A proposed amendment relating to Article B14 regarding funds deletes Paragraphs 7, 8, and 9 and substitutes a new Paragraph 7 which states: "The Finance Committee, under the direction of the Council, shall make recommendations on investment of all funds." The old Paragraph 10 with minor changes in wording is renumbered Paragraph 8.

Honorary Members

Letter-ballot approval of the election of Norris Roy Crump as Honorary Member was confirmed. Upon recommendation of the Board on Honors the following members were elected Honorary Members of the Society: Robert M. Gates, New York, N. Y.; Lewis F. Moody, Plainfield, N. J.; Latham E. Osborne, Pittsburgh, Pa.; and Harry A. Winne, Schenectady, N. Y.

Review of ASME Honors and Awards

The president was authorized to appoint a committee to review the entire pattern of ASME awards with the view to developing new honors, especially incentive awards for young men, and to consider financial support for such awards from trade associations and other sources.

Applied Mechanics Reviews

A plan by which industrial subscribers may reserve a number of copies each month of *Applied Mechanics Reviews* for an annual subscription of $500 was approved.

Materials Handling Handbook

Upon recommendation of the Board on Technology a contract for publication of the Materials Handling Handbook by the Ronald Press, New York, N. Y., was approved.

Staff Pensions

Upon recommendation of the Pension Committee an increase in the maximum pension benefits for staff members was approved. The increase means that maximum pension benefits will now be 60 per cent of salary or $350 per month, whichever is smaller, including Social Security benefits.

Sections

Creation of a subsection at Wichita, Kansas (Kansas City Section), was approved.

Vice-presidents were authorized to clarify all questions concerning Section boundaries by the end of the year.

Regional Delegates Conference

Report and recommendations of the Regional Delegates Conference were received with appreciation and thanks and were referred to appropriate committees, for study.

Student Branches

Because none of the engineering curriculums at the Ohio Northern University is accredited by ECPD and because accreditization does not appear likely in the near future, it was voted to withdraw the student branch from Ohio Northern University, effective in the fall term.

Unity of the Engineering Profession

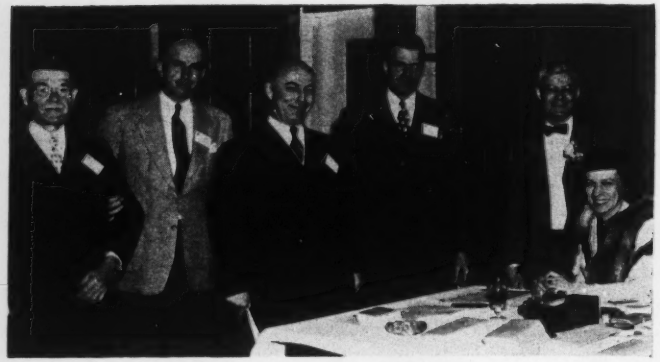
A statement of opinion submitted by the Regional Delegates Conference on the subject of unity of the engineering profession was accepted as the view of the Council. (See page 690 of this issue.)

UPADI

Following a report by past-president James M. Todd of the formation of the Pan-American Union of Engineering Societies (UPADI) at a meeting in Havana, April 19–20, 1951, at which American engineers were represented by EJC, it was voted to authorize EJC to approve the UPADI constitution and to name Mr. Todd first UPADI director from the United States, and S. L. Tyler as the EJC member of the permanent UPADI Constitution and By-Laws Committee.

ECPD

The president was authorized to appoint a representative on the ECPD Committee on Student Development. This is a new committee established to co-ordinate and administer relations between engineering schools, engineering societies, and industry for the purpose of promoting the professional development of engineering students.



ASME CONNECTICUT SECTION HOLDS ANNUAL MEETING AT HARTFORD ROCKLEDGE COUNTRY CLUB, MAY 18, 1951.

(*Left to right:* Harold King, W. F. Thompson, J. Calvin Brown, president ASME; David A. Fisher, F. M. Gunby, Vice-president ASME, Region I; and Miss Hope Wohnus, secretary, Hartford Section. During the afternoon members and guests visited the American Hardware Corporation, New Britain, Conn., and the Fuller Brush Company of Hartford. F. M. Gunby, Vice-president ASME, Region I, reported on the progress being made in unifying the engineering profession. High light of the program was a talk by President J. Calvin Brown on the life of Benjamin Franklin.)

Joint Committee of Design Professions

A report on the division of responsibility among the design professions, drafted by the Joint Committee of Design Professions on which the ASME was represented, was approved in principle.

Charles E. Ferris

The Council noted with regret the death of C. E. Ferris, Honorary Member of the Society, on May 19, 1951.

Appointments

The following appointments were approved: Boiler Code Subcommittee on Heating Boilers, J. N. Briggs, Lynn C. Peal, W. M. Murray, Jr.; Engineers' Council for Professional Development, Guy R. Cowing (reappointed, 3-year term).

Applied Mechanics Division Holds First Western Meeting

STANFORD University was host on June 22–23, 1951, to the first meeting organized by the newly formed West Coast Committee of the Applied Mechanics Division of The American Society of Mechanical Engineers. The registration of 75 fully met the expectations of the committee. Most registrants attended each of the four half-day sessions and offered a lively impromptu discussion from the floor after each of the 16 papers. Encouraged by this success, the Committee is planning to make the Western Meeting an annual event.

Papers on vibrations, nonlinear dynamics, plates and shells, buckling, plasticity, creep, and fatigue, by authors, mostly, but by no means all, from the Western states were presented during four technical sessions. In future years contributions will be welcome from non-Western authors whose travels will bring them to the West at the time of the meeting. The general intention of the Division in initiating these meetings was to bring its facilities to those in the West who would wish to participate in the Eastern and Middle-Western meetings but were prevented by the amount of travel required. Thus, in the future, it is expected that the Applied Mechanics Division will hold its usual national conference in June as well as the Western Meeting.

The Executive Committee of the Division has ruled that papers can be presented at both meetings when the author so desires, and the programs permit.

Papers of both meetings will normally be published in the *Journal of Applied Mechanics*, and preprints made available prior to the presentations.

Inquiries regarding future Western Meetings, and notices of intention to submit papers, should be addressed to the Secretary, West Coast Committee of the ASME Applied Mechanics Division, Prof. R. Bromberg, School of Engineering, University of California at Los Angeles, Los Angeles, Calif. The other members of the committee are: R. G. Folsom (chairman), J. N. Goodier, and M. S. Plesset.

The Stanford meeting this year was arranged by R. S. Ayre, A. Phillips, E. A. Ripperger, D. H. Young, and J. N. Goodier (chairman).

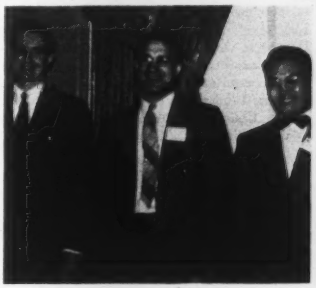
Papers of Current Interest Attract More Than 300 to OGP Conference

A TECHNICAL program touching on many of the current problems confronting the oil and gas power industry attracted an attendance of more than 300 representatives of engine manufacturers, utility operators, petroleum industry, and educators, at the 23rd Annual Conference and Exhibit of the Oil and Gas Power Division of The American Society of Mechanical Engineers, held at the Baker Hotel, Dallas, Texas, June 25–29, 1951.

Among the papers in which considerable interest centered was one which explored the possibility of increasing cylinder ratings without increasing allowable mean-cycle temperatures or exceeding maximum pressures and temperatures common to supercharged Diesel engines of lesser rating. This could be done, according to Ralph Miller, author of the paper, by early cut-off of intake by late closing of the intake valve to allow partial expulsion of the air on the compression stroke. Mr. Miller presented impressive test results on actual engines to support his discussion.

Of general interest also were two papers on the crankcase-explosion problem. The first of these was a study conducted by The Texas Company to determine the role of lubrication oils in explosion phenomena. These studies showed that crankcase atmospheres were always a potential hazard but that a "hot spot" of significant size and high temperature was necessary before an explosion would occur. The paper recommended better design and operation to eliminate hot spots as the best approach to prevention.

The second paper reported studies by the U. S. Naval Engineering Experiment Station to test the efficacy of pressure-relief valves or doors. The paper emphasized the importance of structural strength in relief doors and their fastenings and demonstrated the importance of effective gasketing. Considerable discussion followed these papers during which the "keep air out" advocates and the "ventilate properly" proponents had an opportunity to exchange information.



THREE OF THE FIVE WINNERS OF THE OIL AND GAS POWER DIVISION AWARDS FOR MERITORIOUS PAPERS PRESENTED BEFORE OGP MEETINGS

(*Left to right:* Otto A. Uyehara and P. S. Myers, University of Michigan; and J. D. Stanitz, NACA, Louis Flight Laboratory, Cleveland, Ohio.)

Lecture Series

A feature of the conference was a special lecture series on fundamentals and practical aspects of governing. The two lecturers were: G. Forrest Drake, manager of engineering, Woodward Governor Company, Rockford, Ill., who covered engine characteristics and the need for governing and the nature and details of various governing designs. Charles Concordia, analytical division, General Electric Company, Schenectady, N. Y., lectured on the problems of parallel operation of generators and the effects on engine governing when such units were connected to outside power networks.

Of special interest to the engineers in the public utilities was a panel discussion on engine operation and maintenance during which such topics as municipal plant operation, fuels preparation, water-treating problems, and maintenance procedures were discussed.

AT THE BEEF BARBECUE AND HOEDOWN STAGED FOR ENTERTAINMENT OF MEMBERS AND GUESTS OF THE OIL AND GAS POWER CONFERENCE HELD RECENTLY IN DALLAS, TEXAS

Five Received OGP Awards

At the banquet on Wednesday, General Robert Smith, president, Pioneer Air Lines, of California, who was the main speaker, called attention to the dependence of the United States on vast numbers of underprivileged persons for support of our way of life. Vital steel-alloying agents, for example, he said, could be traced to their source in distant lands, where these materials are mined by primitive methods. With reference to this country's Point Four Program, Mr. Fischer stated that it was essential that this country undertake to improve the conditions of the underprivileged. This will provide an incentive for greater production of materials our economy requires.

As part of the banquet ceremonies, OGP awards for a "meritorious paper ably pre-

ASME Calendar of Coming Events

Sept. 10–14
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Houston, Texas
(Final date for submitting papers was May 1, 1951)

Sept. 24–26
ASME Petroleum Mechanical Engineering Conference, Hotel Mayo, Tulsa, Okla.
(Final date for submitting papers was May 1, 1951)

Sept. 26–28
ASME Fall Meeting, Hotel Radisson, Minneapolis, Minn.
(Final date for submitting papers was May 1, 1951)

Oct. 11–12
ASME Fuels and AIME Coal Divisions Joint Conference, Hotel Roanoke, Roanoke, Va.
(Final date for submitting papers was June 1, 1951)

Nov. 25–30
ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers was July 1, 1951)

March 24–26, 1952
ASME Spring Meeting, University of Washington, Seattle, Wash.
(Final date for submitting papers—Nov. 1, 1951)

June 15–19, 1952
ASME Semi-Annual Meeting, Sheraton Gibson Hotel, Cincinnati, Ohio
(Final date for submitting papers—Jan. 1, 1952)

June 23–27, 1952
ASME Oil and Gas Power Division Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers—Feb. 1, 1952)

Sept. 8–11, 1952
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers—May 1, 1952)

Sept. 8–12, 1952
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland, Ohio
(Final date for submitting papers—May 1, 1952)

Sept. 22–24, 1952
ASME Petroleum Mechanical Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers—May 1, 1952)

Nov. 30–Dec. 5, 1952
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1952)
(For Meetings of Other Societies see page 679)

sented" were awarded to Wallace K. Newcomb for his paper "Principles of Foundation Design for Engines and Compressors"; J. D. Stanitz for his paper, "Analysis of the Exhaust Process in Four-Stroke Reciprocating Engines"; M. M. El Wakil, P. S. Myers, and O. A. Uyehara for their paper, "An Instantaneous and Continuous Sodium Line Reversal Pyrometer." Mr. El Wakil and Mr. Newcomb were not present to receive awards in person.

On Thursday, members and guests enjoyed a traditional barbecue and hoedown at the Grinning Skull Ranch. Ranch-style food and a traditional square-dance festival were features of the entertainment.

Inspection by Air

In an unusual inspection trip, 36 persons boarded two DC-3's early Friday morning for a flight to Corpus Christi, Texas, where they inspected some 8000 Diesel horsepower at work providing power for the processing of oyster shells into cement. On the second leg of the inspection flight, the party flew to Victoria, Texas, where buses took them to the Aluminum Company of America's Point Comfort Plant. Here they saw one of the largest internal-combustion plants in the world. The party returned to Dallas early in the evening.

Another inspection trip of interest was to the Magnolia Field Research Laboratory, Dallas, Texas, where development work in locating oil-bearing areas and various phases of petroleum production were seen.

A ladies program under the chairmanship of Mrs. Henry Robinson, was enjoyed by many wives and guests of members who attended the conference.

Scholarships

FULBRIGHT Awards for lecturing and advanced research in Europe and the Far East are available for graduate students who wish to pursue studies abroad on the predoctoral level. Applications must be mailed not later than Oct. 1, 1951. For forms and additional information write to Executive Secretary, Committee on International Exchange of Persons, Conference Board of Associated Research Councils, 2101 Constitution Avenue, Washington, D. C.

Specializations in Engineering

A CATALOG of more than 400 definitions and delineations of terms used in 19 fields of specialization in engineering was recently published by The American Society of Mechanical Engineers.

The material was prepared for the Office of Naval Research as a special supplement to the recent Survey of Selected Engineering Personnel conducted by the Engineers Joint Council.

The definitions were all reviewed, corrected, and authorized by national societies operating in the fields of the various engineering specialties. In addition to the definitions of occupational specialties, the publication also contains definitions of engineering activities such as research, design, development, and others. The catalog, known as "Definitions of Occupational Specialties in Engineering," may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price per copy is $2.50.

ASME Standards Workshop

Gages

SECTIONAL Committee on Wire and Sheet Metal Gages, B32, at a meeting on June 22, 1951, approved a proposed revision of the American Standard on Preferred Thicknesses. The draft will now be submitted to the American Standards Association for adoption as an American standard.

The standard provides a simple system for designating the thicknesses of uncoated, thin, flat metals and alloys in decimal parts of an inch. This eliminates the confusion caused by the use of different gage number systems in the various metal industries.

The new series of thicknesses is based on the 40-series of preferred numbers. This gives a step-up of about six per cent between each two consecutive thicknesses, as against about twelve per cent in the existing standards, which is based on the 20-series of preferred numbers. The new standard covers a variety of thicknesses which for all practical purposes are equivalent to that of the previous gage systems.

For general-purpose applications the committee feels that the simplified preferred thicknesses given in the standard will facilitate interchangeability of different metals in design, reduce inventory, and increase the availability in warehouse stocks of thicknesses commonly required for general-purpose applications.

Drafting Standards Manual

SIX sections of the proposed American Drafting Standards Manual currently under preparation by the ASA Sectional Committee on Standards for Drawing and Drafting Room Practice, Y14, have been completed and will soon be submitted to industry for comment. These are: Section 2 on line conventions, sectioning, and lettering; Section 3 on projections; Section 4 on axonometric, oblique, and perspective pictorial drawings; Section 7 on sand castings; Section 10 on metal stampings; and Section 13 on flat and helical springs.

When completed the drafting manual is expected to be composed of some 15 sections.

Abbreviations

THE American Standards Association has changed the letter designation of the family of sectional committees dealing with abbreviations and symbol standards from "Z" to "Y" and has designated as Y1 the new sectional committee on abbreviations. Accordingly, Sectional Committee Z10, Letter Symbols; Z14, Drawing and Drafting Practice; Z15, Graphical Presentations; and Z32, Graphical Symbols, will now be identified as Y10, Y14, Y15, and Y32, respectively.

The change was made because these committees have a family identity of their own which is no longer compatible with the Z designation which is intended for miscellaneous projects under the ASA identification Code.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th Street

Chicago
84 East Randolph Street

Detroit
100 Farnsworth Avenue

San Francisco
57 Post Street

Men Available[1]

Industrial Engineer, 31, married, mechanical and business degrees. Experience: three years machine design and three years supervisor of methods and standards department in metal and woodworking plant. Presently employed. Location, immaterial. Me-835.

Mechanical Engineer, 38, single, registered, BSME. Six years' sales engineering with large machinery manufacturer, four years navy engineering officer, and five years mechanical design industrial plants. Desires design position. Prefers Pacific Northwest. Me-836-496-D-13.

Mechanical Engineer, 38, BSME, 12 years design and construction wire-mill machinery and equipment, one year plant engineering in paper industry, and one year plant engineering in process industry. Me-837-106-C.

General Manager, aggressive, has an outstanding record in the management of many engineers and men working on the design, construction, and operation of big industrial projects and coal-mining properties requiring managerial and engineering ability of the highest type. Available now. Me-838.

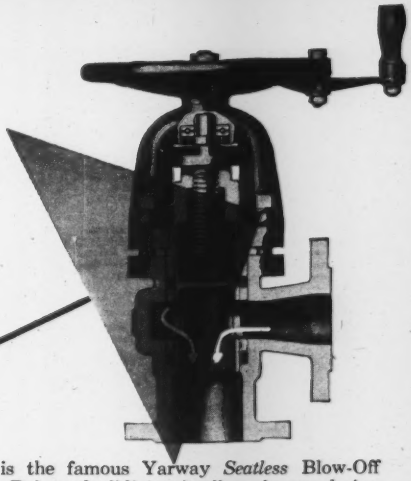
Plant Engineer, BME, nine-year record in product and machinery development, plant

[1] All men listed hold some form of ASME membership.

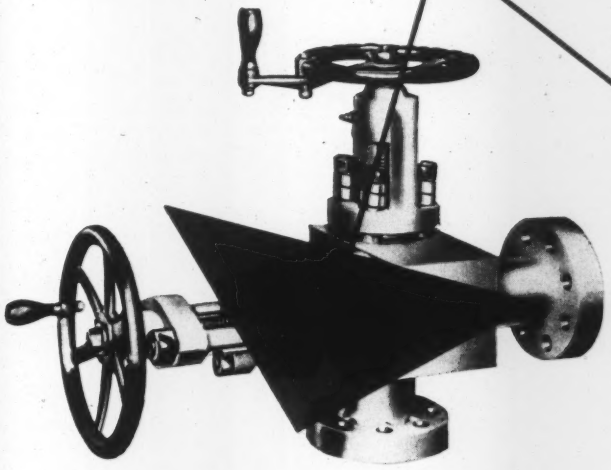
(ASME News continued on page 696)

OVER 15,000 BOILER PLANTS USE THESE BLOW-OFF VALVES

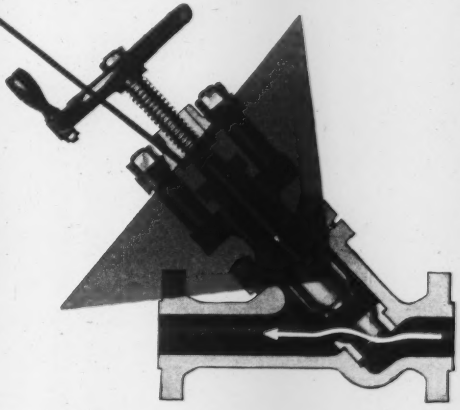
MADE FOR EVERY PRESSURE



This is the famous Yarway *Seatless* Blow-Off Valve. Balanced, sliding, nitralloy plunger design eliminates seat—a common source of wear, clogging and leaking. Type B (above) for pressures 50 to 400 psi, angle or straightway, single or tandem. Other types available for higher pressures. Complete description and specifications in Bulletin B-424 for pressures to 400 psi, or Bulletin B-433 for higher pressures.



The Unit Tandem—Yarway's finest blow-off valve for high pressure service. Combines a Hard Seat Valve (for blowing) and a Seatless Valve (for sealing) in a one-piece forged-steel body, flanged or socket welding ends. Also available combining two hard-seat valves. For pressures to 2500 psi. See Bulletin B-433.



This is Yarway's Stellite-Seat Valve for pressures to 2500 psi. Shown here in open position. Disc and seat ring are stellite-faced and carefully mated for tight seating, long life and hard wear. Angle or straightway, single or tandem combinations (hard seat—hard seat or hard seat—seatless) available. Complete specifications and description in Yarway Bulletin B-433.

YARNALL-WARING COMPANY • 108 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

STEAM PLANT EQUIPMENT

layout, production planning, maintenance administration, vendor and contractor negotiation, materials-handling systems, diverse industries. Me-839.

Sales Engineer, 26, married, veteran, BSME, 1948, Duke University. Three years' experience. Desires industrial selling covering N. C. and S. C. area. Preferably based in Charlotte, N. C. Me-840.

Power-Plant or Maintenance Superintendent, 49, BS in general engineering, married, one child, 20 years' experience in steel plant and three years with chemical-process plant, power generation and distribution. Prefers Southeast. Me-841.

Positions Available

Product-Design Engineer for company manufacturing automotive accessories, particularly automotive-lighting equipment. Must understand tool and die design, labor and material costs, etc. $7000–$9000. N. Y. State. Y-5607.

Division Manager, under 45, master's degree in mechanical, electrical, or industrial engineering, including courses in metaphysics, psychology, and economics. Should have ten years' experience in engineering work including development, research, design, prototype, methods, time-and-motion study, plant layout, machine design, etc. At least five of these years should have been as a manager. Company manufactures gas and electric-water heaters and space heaters, and other household appliances. $10,000 plus profit bonus. Calif. Y-5612.

Chief Design Engineer or **Design Engineer,** experience in the design of rolling-mill equipment for medium-sized plant employing 600–800 people. $12,000 for principal position. Conn. Y-5613.

Industrial Engineer, 30-45, preferably mechanical graduate, to supervise the methods, tool design, toolmaking, and procurement functions in one of the company's plants. Work consists of light and medium machining and assembly, including automatic-screw machines, semiautomatic chucking machines, turret lathes, drill presses, and various types of the hydraulic seating machines, including Heald Boremattics. Salary open. Ohio. Y-5616.

Assistant to President, 30–45, for manufacture of rolling-mill and special machinery; foundry; machine shop. Should be mechanical engineer, experienced in the manufacture of heavy machinery and practical knowledge of the operation of foundries and machine shops. Production experience important. $10,000. Eastern Pa. Y-5652.

Engineers. (*a*) Mechanical engineer, two or three years' experience in machine design and stress analysis. Will work in research and development division on printing-press design. $4092–$5436. (*b*) Methods engineers, one or more years' of machine-shop time-study experience. $4284 a year for several years' experience; $3764 for juniors. (*c*) Wage analyst, preferably one who is thoroughly experienced in machine-shop job evaluations and machine-shop operations. $5088–$5436. Will consider a trainee who has graduated from recognized college. N. Y. Metropolitan area. Y-5655.

Piping Engineer and Estimator, graduate preferred, who has had specific experience in estimating and good knowledge of power and industrial-piping jobs. Must have good knowledge of labor operations and some field construction. Also desirable that he have some knowledge of office routine. Position will eventually lead to taking over estimating division. Salary open. New York, N. Y. Y-5668.

Chief Engineer, 35–50, mechanical or civil engineer, at least ten years' design experience covering heavy industrial cranes, to supervise design engineers and draftsmen for well-established firm manufacturing custom-built heavy handling equipment and industrial buildings. $9000–$12,000. Northwest. Y-5685.

Mechanical or **Metallurgical Engineer,** general background in light metals such as aluminum, magnesium, or titanium, for statistical control and co-ordination to manufacturing divisions. $7600. Washington, D. C. Y-5699.

Supervisor of commercial research and development, about 35, preferably an industrial-engineering graduate, but mechanical, electrical, or chemical graduate will be considered, for manufacturer of mechanical and electronic products for use in industry. Five to ten years' experience in industry, with industrial or management-engineering background, or experience in modern analysis of distribution or marketing operations, or a combination of both. Salary open. Conn. Y-5705.

Mechanical Engineer, graduate, 35–45, to head up all plant-maintenance activities. Should have five to ten years' experience in heavy manufacturing industry, supervising all maintenance activities. Man who is now principal assistant to chief engineer in a large plant or the top plant engineer in a smaller plant preferred. Additional experience in production-management and industrial-engineering work desirable. $9000–$11,000. W. Va. Y-5709.

Maintenance Engineer, mechanical, experience in the maintenance of heavy chemical and electric furnace equipment. $7200. W. Va. Y-5715(*c*).

Plant Engineer, 40–45, mechanical graduate, at least ten years' process-plant engineering experience, to take complete charge of design and development, maintenance, construction, and power plant of food manufacturer. $10,000–$12,000. Mich. Y-5718.

Chief Engineer or Superintendent of Maintenance and Engineering, mechanical or chemical, with proved satisfactory experience in power and steam generation; engineering, installation, and maintenance of chemical equipment, such as stills, evaporators, pumps, driers, etc., and chemical-plant layout. Must have progressive ideas and ability to apply them in a large plant and at same time supervise both engineering and maintenance staff. About $12,000. Midwest. D-6989.

Chief Product Engineer, 35–40, practical experience in mechanical-engineering problems necessary in producing stampings, finishing, and assembly operations related to the manufacture of automotive accessories; with working knowledge of electric motors, related controls, and electrical devices. Must be cost-conscious and capable of dealing with top-level personnel. Salary open. Mich. D-7035.

Chief Engineer, 38–48, with mechanical and chemical-engineering training and experience in design, production, and application of machinery for process industries. Must have good record working with people. $18,000 and bonus. Northern Calif. S-1028(*a*).

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Aug. 25, 1951, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & J = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

BADER, F. J., San Francisco, Calif.
BARIBAULT, JULES D., New Orleans, La.
BORNE, FREDERICK P., Salem, N. H.
BOVA, EUGENE S., Youngstown, Ohio
BRAUN, WILLIAM J., Syracuse, N. Y.
BROWN, ROGER H., Union, N. J.
CAMPBELL, JAMES E., Charlotte, N. C.
CARLSON, ROBERT I., Orange, Mass.
CHRISTOFFERSON, L. F., Seattle, Wash.
CLEMENT, RICHARD W., Valley Stream, N. Y.
CRAIG, ELZIE S., Parkersburg, W. Va.
CRAWFORD, WILLIAM B., Jr., Atlanta, Ga.
CRAWFORD, WILLIAM B., Sr., East Point, Ga.
CULBERTSON, ROBERT L., Erie, Pa.
DESAI, MOGHABHAI C., Surat, Bombay, India
DONOHUE, J. PAUL, Westfield, N. J. (Rt & T)
DUBITSKE, MITCHEL, Brookline, Mass.
DUMAS, W. B., Kingsville, Texas
ESTABROOK, GEORGE A., Albany, N. Y.
FREESE, LEONARD B., Coulee Dam, Wash.
GARDNER, J. B., San Francisco, Calif.
GARREN, H. E., Atlanta, Ga.
HALL, KEITH W., Ann Arbor, Mich.
HAMMOND, WILLIAM E., Wellsville, N. Y.
HORGH, ROY A., Jr., Chicago, Ill.
HOLDER, LOUIS A., Canton, Ohio
HOUSIAUX, JOHN E., Omaha, Neb.
HUBER, VICTOR L., St. Louis, Mo.
HUDSON, WILLIAM G., Westfield, N. J.
JAREMUS, BOUBENE M., Peoria, Ill.
JOURDAN, JOHN, St. Louis, Mo.
KALAM, ABDUL, Saidpur, East Pakistan
KARCHNER, ORVAL O., Danville, Pa.
KLENZ, KARL A., San Francisco, Calif.
KLOEBLEN, EMIL, New York, N. Y.
MAXIN, RAYMOND, Philadelphia, Pa.
MAYER, THOMAS E., Buffalo, N. Y.
MCCALL, ROGER F., Houston, Texas
MCGOWAN, GAYLON H., Fanwood, N. J.
MCGRATH, GEORGE R., Amsterdam, N. Y.
MILLER, CHARLES B., Long Beach, Calif.
MINNICK, LEROY P., Bellefonte, Pa.
NEELY, GLEN W., Oak Park, Ill.
NICKLAS, JOHN W., Allentown, Pa.
OTTESEN, REALF, Trondheim, Norway
PASQUA, P. F., Evanston, Ill.
RAE, THOMAS D., Huntington, N. Y.
RICH, JOSEPH E., Richmond, Va.
ROBERTS, GENE, Middletown, Ohio
RUZICKA, G. J., Maywood, N. J.
SAVOIE, CHARLES C., Sr., Belle Rose, La.
SCHACTER, MAX, Newark, N. J.
SCHIAVONE, DANIEL C., Tonawanda, N. Y.
SESLER, FRANK E., Jr., Los Angeles, Calif.
SHIPMAN, JOHNSON, Palmerton, Pa.
SMILLIE, WM. D., Galt, Ont., Can.
SMITH, LEROY K., Caracas, Venezuela, S. A.
STARK, CONRAD F., Wellsville, N. Y.
STEEDS, WILLIAM, Shrivenham, Swindon, England
TEETER, MACY O., Jr., New Orleans, La.
VERMA, RAMJEE PRASAD, Cambridge, Mass.
VINCOTTE, RICHARD, Brussels, Belgium
WARD, JOSEPH R., Elsmere, Del.
WARNER, WILBUR D., Chicago, Ill.
WHITEHILL, CASSIUS F., Franklin, Pa.
WILCOX, LOREN H., Salina, Kan.
WILLS, WILLIAM, Jr., New York, N. Y.
WILSON, LLOYD W., Oil City, Pa.
ZERBE, FREDERICK K., Houston, Texas
ZINK, THOMAS F., Baltimore, Md.

CHANGE IN GRADING

Transfers to Member and Associate

BAUDER, BURTON E., Newark, N. J.
BRIGHT, JAMES R., Lexington, Mass.
CARMICHAEL, JAMES T., Shreveport, La.
COLE, RALPH A., East Lansing, Mich.
FAASSE, WILLIAM, Barberton, Ohio
FISCH, ROLAND V., Willoughby, Ohio
GROOM, CLAUDE H., Tulsa, Okla.
GULBALIS, T. A., Tripoli, Lebanon
HENDRY, WICKLIFFE B., St. Paul, Minn.
HILDAGE, RICHARD B., Kingsport, Tenn.
HODGE, GORDON N., North Plainfield, N. J.
JUSTICE, RUSSELL W., Jr., Fullerton, Calif.
LIEN, GEORGE E., Port Washington, N. Y.
LINN, MARVIN H., Rock Island, Ill.
LONG, ROBERT C., Syracuse, N. Y.
LONGMAID, SYDNEY E., Camden, N. J.
MCCONNELL, RICHARD U., Long Beach, Calif.
MESSINGER, JOE P., New York, N. Y.
PAUKNER, FRANK J., Richmond Hill, N. Y.
PUGH, GEORGE A., Youngstown, Ohio
SCHARNBERG, LESTER N., Pittsburgh, Pa.
SCHEFFEL, M. L., Boston, Mass.
SCHEY, IRA M., Jr., Lenoir, N. C.
SCHUMANN, EDWARD O., Scranton, Pa.
SEVERSON, ASBJORN M., Minneapolis, Minn.
SHRADER, HAROLD E., Chattanooga, Tenn.
SMITH, GEORGE W., Marshfield, Wis.
TESSMER, RAYMOND G., North Tonawanda, N. Y.
TONER, GILBERT H., Seattle, Wash.
WADDELL, CHARLES E., Brooklyn, N. Y.
WEISS, HERBERT K., Aberdeen, Md.

Transfers from Student Member to Junior 300

Obituaries

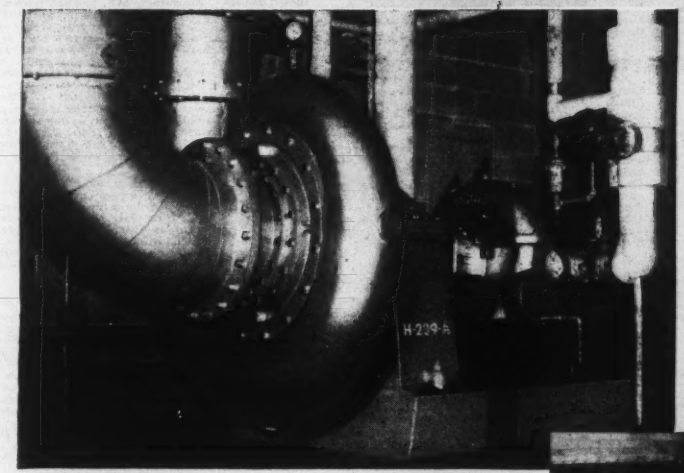
Reidar Carlsrud (1896–1951)

REIDAR CARLSRUD, distributor for New England States, representing Dartell Laboratories, Los Angeles, Calif., died May 6, 1951, at his home in Unionville, Conn. Born, Porsgrund, Norway, Jan. 15, 1896. Parents, Karl and Mathilde (Mathiesen) Carlsrud. Education, ME, S.M.F. Porsgrund, 1917. Took special courses at the technical college, Streliz, Germany, 1921–1922, and Friedberg, Germany, 1922–1924. Naturalized U. S. citizen, 1931. Married Irene Lillian Martin, 1934. Assoc.Mem. ASME, 1927; Mem. ASME, 1935. Survived by wife and two sons, Carl Martin and Glenn Bernhardt.

William Shubael Conant (1868–1951?)

WILLIAM S. CONANT whose death was recently reported to the Society, was a consulting engi-

(*ASME News continued on page 698*)



CENTRIFUGAL

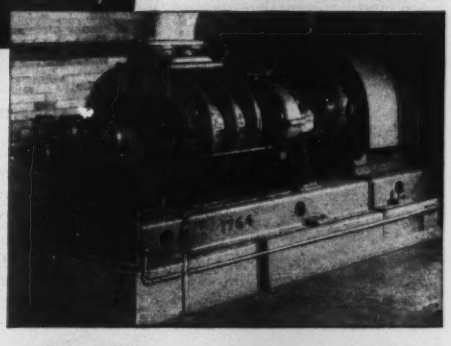
Type OIB Centrifugal Blower used for processing in a large eastern plant. Capacity 12,000 cfm. Similar R-C Blowers are utilized in other plants of this company.

The works manager of a large plant made this friendly statement to a Roots-Connersville representative. What he really meant was that R-C Blowers and related equipment perform so satisfactorily and dependably that they seldom need anything more than routine inspection by his own men.

In large and small plants, in every industry, R-C products uniformly give this kind of reliable operation. They continue to deliver rated capacities, year after year, with a minimum of maintenance—whether a small Rotary Positive Blower of 5 cfm capacity or a Centrifugal unit moving up to 100,000 cfm. And remember, only Roots-Connersville gives you this dual-choice.

If you are planning a new plant, expansion, or replacements, R-C engineers will work with you to select the equipment best fitted to your needs. Almost a century of experience is at your service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Michigan Avenue, Connersville, Indiana



ROTARY

One of two Type RCDH Rotary Positive units in vacuum service in a power plant. Capacities 3,380 cfm. and 3,490 cfm., respectively.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

neer, Washington, D. C. Born, Detroit, Mich., Jan. 17, 1868. Parents, John S. and Mary (McLaren) Conant. Education, BA, Princeton University, 1890; EE, 1892. Married Frances E. Wendling, 1901. Jun. ASME, 1895; Mem. ASME, 1904. He had contributed articles to technical journals, had several inventions patented, and had been connected in an official capacity with professional societies. He served on the ASME Committee for Education and Training for the Industries and was chairman, American Engineering Council's Committee on Water Resources.

Charles Edward Ferris (1864–1951)

CHARLES E. FERRIS, dean emeritus, college of engineering, University of Tennessee, died May 19, 1951. Born, Napoleon, Ohio, Sept. 23, 1864. Parents, George N. and Adelia M. (Harris) Ferris. Education, BS, Michigan State College, 1890; McGill University, Montreal, Que., Can. Married Lillian LaCore, 1892 (deceased); children, George Marvin, Georgia May. Married 2nd, Katherine Stoltzfus, 1906; children, Mary Elizabeth, Katherine Holley. He was the author of "Elements of Descriptive Geometry," "Manual for Engineers," and "Thermodynamics." Mem. ASME, 1904; Hon. Mem. ASME, 1942. Survived by wife and three children, George M., Athens, Tenn.; Mrs. William E. Newell and Mrs. Robert R. Scott, Jr., both of Knoxville, Tenn.

Clifford Theodore Grove (1907–1950)

CLIFFORD T. GROVE, engineer, Valley Manufacturing Plant, Valley, Neb., died in Omaha, Neb., Nov. 7, 1950. Born, Evart, Mich., Jan. 13, 1907. Parents, Clifford Peter and Iona (Smith) Grove. Education, BS in Physics, Morningside College, Sioux City, Iowa; BSME, University of Iowa, 1941. Married Opal Joy Hall, 1941. Jun. ASME, 1941. Survived by wife and daughter, Carol Joy.

Fred Wilson Hart (1869–1951?)

FRED W. HART, whose death was recently reported to the Society, was a retired construction and electrical engineer, Denver, Colo. Born, Marietta, Ohio, Nov. 18, 1869. Education, four years' special work, Denver University, two years as superintendent of university shops. Mem. ASME, 1919.

Mayo Seevers Heath (1923–1951)

MAYO S. HEATH, 1st Lieut. air-borne ranger company, was killed in action in Korea, Feb. 15, 1951. Born, Franklin, Ind., Oct. 7, 1923. Parents, Dwight F. and Helen (Seevers) Heath. Education, BSME, Carnegie Institute of Technology, 1947. Married Arline Chakmak, 1945. Jun. ASME, 1948. Survived by wife, daughter, Deborah Mayo; his parents and a sister, Charlotte R., and a brother, Dwight P., Jun. ASME.

Gustav Henry Kaemmerling (1890–1950)

GUSTAV H. KAEMMERLING, administrative assistant to engineering division, in charge of intercompany patent activities, Lord Manufacturing Co., Erie, Pa., died Oct. 3, 1950. Born, Partick, Glasgow, Scotland, April 11, 1890, of American parents. Parents, Gustav and Effie (Barnhurst) Kaemmerling. Education, AB, Harvard University, 1912. Married Henrietta Dorris, 1950. Jun. ASME, 1916; Assoc. Mem. ASME, 1922; Mem. ASME, 1935. Inventor of eight patented devices in resilient mounting and measuring instruments fields. Survived by wife and mother.

Frank Solon Luney (1884–1951)

FRANK S. LUNEY, chief engineer, The Meaker Co., Chicago, Ill., died May 19, 1951. Born, DeKalb, Ill., May 12, 1884. Parents, Thomas A. and Anna (Solon) Luney. Education, BS, University of Illinois, 1907; ME, 1921. Married Jeannette Murray, 1912. Mem. ASME, 1936. Survived by wife and four children, Thomas M., Hammond, Ind.; Mrs. Jane (George B.) Butters, W. Hyattsville, Md.; May J., USMTC, San Diego, Calif.; Robert B., Hammond, Ind.; and three grandchildren.

Franklin W. Olin (1860–1951)

FRANKLIN W. OLIN, founder and director of Olin Industries, died in Barnes Hospital, St. Louis, Mo., May 21, 1951. Born, Woodford, Vt., Jan. 9, 1860. Parents, Truman and Sarah Ann Olin. Education, CE, Cornell University, 1886. Married Mary Mott Moulton, 1889. During World War II Mr. Olin, through a wartime subsidiary—U. S. Cartridge Co.—operated the largest small-arms ammunition plant in United States history, at St. Louis. The plant turned out more than six billion rounds of rifle and machine-gun ammunition under government contract. Survived by wife and two sons, John Merrill and Spencer Truman, Mem. ASME; six grandchildren and four great-grandchildren.

Ward Saunders Patterson (1904–1951)

WARD S. PATTERSON, executive assistant to the vice-president in charge of engineering, Combustion Engineering-Superheater, Inc., New York, N. Y., died May 21, 1951. Born, Rangeley, Me., Nov. 3, 1904. Parents, Harley J. and Marie H. Patterson. Education, ME, Cornell University, 1926. Married Helene C. Tweeddale, 1929. Jun. ASME, 1926; Mem. ASME, 1937. Since 1935 he had served the Society as a member of the Heat Transfer Division. He held numerous patents pertaining to air preheaters, burners, and boilers. He was the author of papers published in Transactions of the ASME and other technical journals. Survived by wife, son Albert, and daughter Joyce; his father and two brothers, Arnold and Carsten.

Eugene Colfax Peck (1867–1950)

EUGENE C. PECK, retired, president, General Automatic Corp., Macedonia, Ohio, died in Hollywood, Fla., Dec. 30, 1950. Born, Akron, Ohio, Dec. 20, 1867. Parents, Hubert C. and Lydia C. Peck. Education, graduate, Akron (Ohio) High School. Married Ivy Kesler, 1889. Mem. ASME, 1909. He was presented with the Legion of Honor, order of Black Star, by the French Government, 1919. Survived by wife and son, Lionel S., Macedonia, Ohio.

Henry Charles Schatz, Sr. (1891–1950)

HENRY C. SCHATZ, SR., superintendent, South Carolina Electric and Gas Co., died August, 1950. Born, Spring Valley, Pa., July 18, 1891. Education, attended John Wanamaker Commercial Institute, 1905–1909. Mem. ASME, 1949.

Kenneth Emmons Stuart (1876–1951)

KENNETH E. STUART, research engineer and patent attorney, died May 23, 1951, at his home in Merion, Pa. Born, Newark, N. J., May 26, 1876. Parents, Charles W. and Caroline (Emmons) Stuart. Education, ME, Cornell University, 1897. Married Edith Crosby Brown, 1912. Mem. ASME, 1919. He held over 100 patents on many electrical and chemical devices and designed an automatic underground railway for the London postoffice. He served as a member of the National Research Council during the first world war and engaged in confidential work on the Manhattan Project in the second. He designed an electrolytic cell which reportedly supplied more than half of the nation's chlorine during the second world war. He was the author of a number of articles for scientific periodicals. Survived by wife and a sister, Mrs. George Perkins.

Robert Ellis Thayer (1883–1951)

ROBERT E. THAYER, vice-president and a director of Simmons-Boardman Publishing Corp., New York, N. Y., died Feb. 25, 1951. Born, Chelsea, Mass., Aug. 4, 1883. Parents, James Franklin and Cornelia May Thayer. Education, BS, Massachusetts Institute of Technology, 1907. Married Maud J. Gilbert, 1910; son, Gilbert. Jun. ASME, 1911; Mem. ASME, 1919.

Paul Claiborne Van Zandt (1878–1951)

PAUL C. VAN ZANDT, retired cement engineer, died May 26, 1951, at his home in River Forest, Ill. Born, River Forest, Ill., May 2, 1878. Parents, George and Huldah (Barrow) Van Zandt. Education, BSME, Purdue University, 1899. Married Alice N. Shonk, 1902; children, Claiborne Charles, Howard Franklin, Rollin Paul. Jun. ASME, 1900; Assoc. ASME, 1907; Mem. ASME, 1909. In 1918 he became chief engineer of the Asano Cement Co., with headquarters in Tokyo, and remained there until 1923. He was credited with being one of the founders of Japan's cement industry, now second only to the textile industry.

Robert Wales (1890–1951)

ROBERT WALES, technical director, Compania Cubana De Fianzas, Havana, Cuba, died April 18, 1951. Born, Stranraer, Scotland, Aug. 7, 1890. Parents, James and Helen (McGuffog) Wales. Education, attended Southern's Marine Engineering College, Glasgow, Scotland, 1908–1910. Married Helen Donnan, 1910. Mem. ASME, 1936. Survived by wife.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last — First — Middle)

Home address ..... ☐ (Street — City — Zone — State)

Name of employer .....

Address of employer ..... ☐ (Street — City — Zone — State)

Product or service of company .....

Title of position held .....

Nature of work done .....

I am a subscriber of (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

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Keep Your ASME Records Up to Date

HEADQUARTERS depends on its master membership file for answers to hundreds of inquiries daily pertaining to its members. All other Society records and files are kept up to date through changes processed through it. The listings in future ASME Membership Lists will be taken directly from the master file. It is important to you that it lists your latest mailing address and your current business connection.

Four weeks are required for complete processing of address changes.

The mailing form on this page is published for your convenience. You are urged to use it in reporting recent changes.

Your mailing address is important to Headquarters. Please check whether you want your mail sent to home or office address.

NEW TRANE BRAZED ALUMINUM SURFACE

MORE HEAT TRANSFER EFFICIENCY

in $\frac{1}{4}$ the space

with $\frac{1}{3}$ the weight

at $\frac{1}{2}$ the cost

A Smaller Unit Can Do A Bigger Job

More heat transfer from every cubic foot of space, more Btu's from every pound of surface, more Btu's per dollar—with the new Trane Brazed Aluminum Heat Transfer Surface.

Many of these Brazed Aluminum Units can pack *450 square feet* of heat transfer surface—working surface—into *one cubic foot*. That's up to *nine times* more surface than a shell-and-tube unit with ¾" tube can put into the same space.

In a given space, the units can meet practically any specifications of heat transfer, pressure drop, volume, number and direction of passes, and fluid velocity.

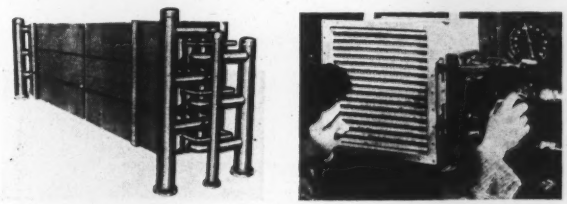
All aluminum, the units are much lighter than shell-and-tube heat exchangers—often needing only ¼ the weight to do the same job.

The units handle as many as five liquid or gas streams at once. Headers can be designed for any job.

Trane Brazed Aluminum Surface, evenly brazed in an exclusive flux bath process, is as rugged as it is flexible—it takes test pressures up to 1,000 lbs. per square inch, temperatures from −300°F. to 500°F.

Because they pack so much heat exchange surface into every cubic foot, and because of advanced manufacturing techniques, the units are much less costly than conventional equipment—a smaller unit can do a bigger job. *Trane Brazed Aluminum Units can often do the same heat transfer job as tubular exchangers that cost two or three times more.*

If you have a heat transfer job—one that demands a large number of units—Trane Brazed Aluminum Surface may be the answer. Contact your nearest Trane sales office, or write direct.



Large units—left, or small—at right, flexible Trane Brazed Aluminum Surface provides heat transfer efficiency.

THE TRANE COMPANY, LA CROSSE, WISCONSIN
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Trane Company of Canada, Ltd. . . . . Toronto
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TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

Power House and Process Piping at new 60-acre Pfizer Plant equipped for years ahead with

Jenkins Valves

General Contractors, W. J. BARNEY CORP. Piping Contractors, J. H. MERRITT CO.

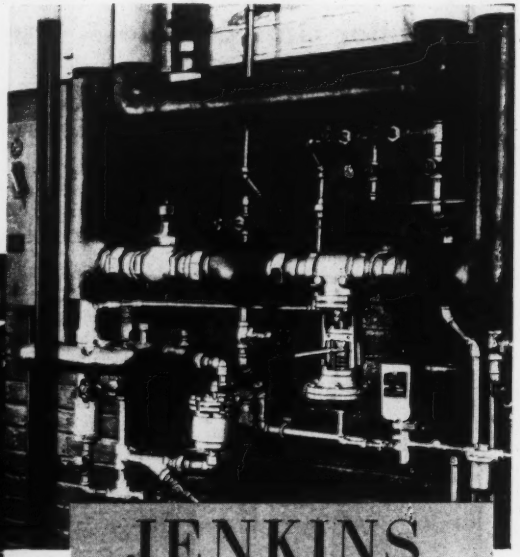
At Groton, Connecticut, the new plant of Chas. Pfizer & Co., Inc., provides additional capacity to meet mounting demands for this company's fine chemicals and antibiotics.

In Pfizer's continuous process manufacture of these products, the dependability of the heat and power supply is vital. That is why you'll find Jenkins Valves in the new power plant, and, in fact, throughout the intricate network of process pipelines.

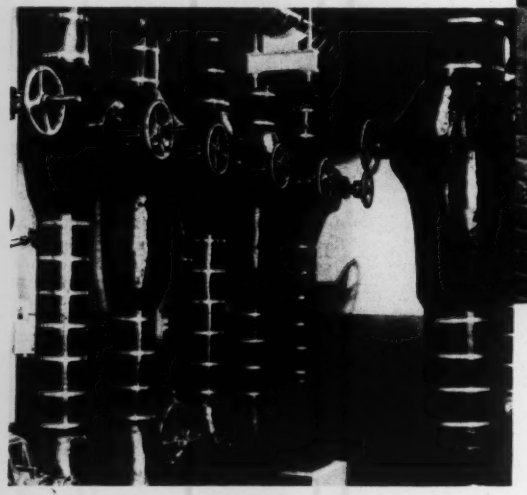
Because the power demand is endless, it requires—even in normal times—unfaltering efficiency of all component equipment. And because operating economy depends on *continued* efficiency in the years ahead, Jenkins Valves have long been the choice of the men who plan, build, operate, and maintain the nation's vital power installations.

They know that Jenkins builds *extra* endurance into valves. Yet despite this *extra* value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Avenue, New York 17. Jenkins Bros., Ltd., Montreal.

Some of the Jenkins Valves installed in the Pfizer power plant. Its rating is 230,000 lbs. per hour from two oil-fired boilers.



Large Jenkins Gate Valves on pipelines serving the 12-step Pfizer process of synthesizing a stable form of crystalline Vitamin A, the first produced on a commercial scale.



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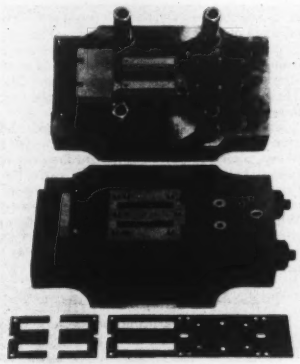
• NEW EQUIPMENT

Sintered Carbide Die Section Standards

New "standards" for sintered carbide die sections have been established through the co-operation of Firth Sterling engineers and a representative number of leading tool and die makers. The new standards apply to a wide range of sizes for punches, perforators, pilots, bushings, and rectangular sections. They are supplied in a "universal" grade of sintered carbide.



Initial applications of sintered carbides to blanking dies over a decade ago, made production increases of 10 to 1 over alloy steel dies. Production runs of 70 to 100 millions of pieces of "E" and "I" transformer sections punched from silicon steel sheet were typical of the earlier applications. Trade acceptance was almost immediate. Now, production of over 350 millions of pieces blanked from 0.025-in. silicon steel sheet is a common report where Firth Sterling's relatively new Diecarb-X is used for the die sections.

The Diecarb equipped die is made up of 9 standard rectangular sections, 8 standard punches, 8 standard bushings, and 6 non-standard punches and bushings. The holes and special shaping required on the standard rectangular pieces were preformed while the Diecarb was in the half-sintered condition.

Following the experience gained from the application of sintered carbides to cutting tools, Firth Sterling developed four Diecarb grades for use in blanking dies. This enabled the die designer to select a grade which had the required impact/abrasion resistance ratio to do a specific job most efficiently. However, the need for a "universal" grade that had a well-balanced impact/abrasion resistance ratio became urgent with the expansion of the metalworking facilities following World War II.

With the development of the new universal grade, Diecarb-X, the setting-up of size and shape standards became practical. As a result, it was possible for the carbide manufacturer and die makers to set up stock inventories to facilitate better deliveries to the trade.

The largest size listed as standard is $1^1/_4 \times 2^1/_4 \times 6$ in. for rectangular shapes in the half-sintered condition. If any special shaping is required on the standard rectangular piece, the machining is done and the piece is then final-sintered. The maximum size of Diecarb that can be presently supplied, other than standard, is a piece that can be circumscribed by a 20-in-diam circle.

The bushings are supplied in three styles in a total of 50 sizes. They are stocked in the final-sintered condition. Punches are stocked in the "as-sintered" condition and the standard sizes are sufficiently oversize to allow for finish grinding to size by the die maker. Stock oversize allowance applies to all the standard Diecarb items. Punches are also available in the "ground" condition as standard and require only fine finish grinding or lapping for use in the die section. Perforators are stocked in the "as-sintered" condition in all standard sizes.

High-Head Pumps

A completely redesigned line of two-stage pumps, designated as "Type DMD," is announced by Economy Pumps, Inc., division of Hamilton-Thomas Corp., Hamilton, Ohio.

In the redesigning process, the pumps have been improved with regard to compactness, pumping efficiency, and mechanical ruggedness. Type DMD pumps are made in sizes from 2 to 10 in. discharge; capacities up to 4000 gpm and heads to 750 ft.

The two-stage design is said to be most effective in that a single DMD pump, driven by a single motor, produces as much head as two single-stage pumps piped in series. Former Economy DMD pumps are used, and the new models recommended, for services such as high-head water works, building water supply, hydraulic elevators, oil refineries, mines, chemical plants, boiler feeding, and many other allied uses.

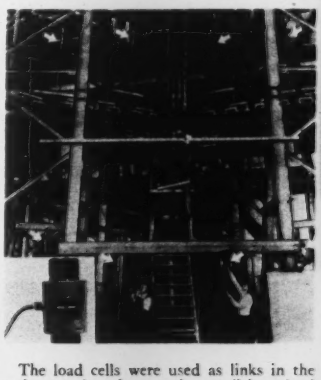
The DMD pump is an economical unit for rugged service, incorporating many mechanical features to assure long and reliable service. Among outstanding features, the manufacturer lists: A horizontally split casing with interconnecting passage between the two opposed impellers. The impellers are the nonoverloading type, hydraulically and dynamically balanced at the factory. The large-diameter shaft is carried on heavy-duty cartridge-type dust-proof ball bearings. For thrust, an angular contact duplex bearing is used. Radial load is supported by a double-row ball bearing.

A new bulletin, showing design and construction features of the pumps as well as operating data and performance charts, is available from the manufacturer: Economy Pumps, Inc., Hamilton, Ohio.

Electronic Stress Measurements

One of the most extensive applications of electronic stress measurement ever attempted was successfully concluded recently by Boeing Airplane Co. in elaborate structural tests of the B-47 Stratojet bomber at Wichita, Kan.

Thirty-two tension load cells incorporating special Baldwin SR-4 bonded resistance wire strain gages were in use during the major tests. Although they measured loads at extreme locations on the airplane, all loads were read at a central point into which the cells were wired to two self-balancing indicators. This was made possible by the fact that the indicator was calibrated in per cent load rather than pounds, and all of the cells were matched and calibrated to rated capacity at 100 per cent on the indicator. Each reading of each cell required about 10 sec.



The load cells were used as links in the main trunk of several equalizing load harnesses to measure wing and tail loads, and to other loading members for measuring fuselage loads, empennage loads, door loads, and reaction loads totaling more than 700,000 lb on the 185,000-lb bomber. In some instances the cell was attached between the reaction point and a rigid structure without being in series with a loading ram.

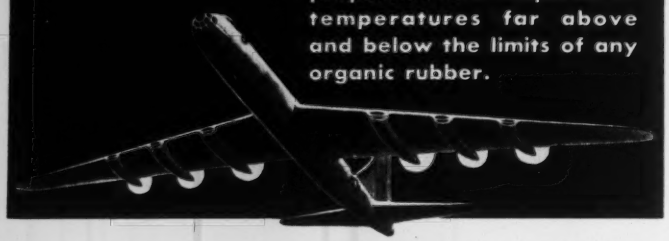
Most of the 32 cells were installed in the loading system in series with hydraulic rams which were pressured by a battery of manually operated jacks. Hydraulic pressure gages were read for approximate adjustments but final adjustment or corrections were made from the Baldwin SR-4 load cells. These cells, which have capacities of 20,000

Continued on Page 42

materials in the CONVAIR B-36 must withstand temperatures from 100 to −500 F.

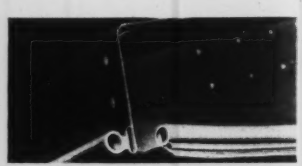
that's why SILASTIC*

is used wherever rubberlike properties are required at temperatures far above and below the limits of any organic rubber.



Silastic boots are used to increase the reliability and to prevent corrosion and untimely shorting of the limit control switches made by Exhibit Supply Company. They retain their strength and flexibility at temperatures of −100° F.

Silastic gaskets reinforced with glass cloth are used to seal the rocker arm housings in Pratt and Whitney "Wasp Major" engines. They withstand hot oil at operating temperatures in the range of 450° F.



Silastic is used to seal bomb bay doors and the cover plates, doors and windows in camera bays, where flexibility and resilience are required at temperatures ranging from −100° to +160° F.

Silastic gaskets reinforced with glass cloth are used to seal the cabin heating and pressurizing systems at operating temperatures in the range of −70° to 400° F.

For more data on Silastic phone our nearest branch office or write for New Silastic Facts data sheet Q-8.

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• Keep Informed

lb, 50,000 lb, and 100,000 lb, were checked periodically and proved to have high accuracy and excellent stability.

The load cell is basically a bar of steel on which special 250-ohm strain gages are bonded. They have threads on both ends for loading fixtures of any desired type. The bar is protected by a steel case in which it is sealed by means of "O" rings. The largest cell is only 15 in. long and 3 in. in diam at the threaded ends. The cover is $4\frac{1}{4}$ in. in diam. The length between clevis pin centerlines is 23 in. (approximately). Although compression cells are also available, none were used on these tests.

In addition to SR-4 load cells for stress measurements hundreds of SR-4 strain gages were applied directly on the wings and other parts of the airplane at critical points to measure strains. These were also read at the central point by means of other indicating instruments. Leeds & Northrup Type G Speedomax indicators were used for all measurements.

Rubber-Lined Valve

Developed by R-S Products Corp., Philadelphia, Pa., for emergency gas or liquid shut-off service, a heavy-duty cast-iron valve No. 763 is rubber-seated. With the angular seating vane for wedge-type closure, the rubber is compressed around the periphery of the vane to give positive shut-off even around the shaft bosses. This type of construction makes it possible to use an iron body valve in service that would normally call for stainless steel or other alloy. The rubber flanges take the place of the usual flange gaskets.

The valve is completely cycled and operated by a directly connected motor-driven pump, sealed in oil. The hydraulic pressure raises the counterweight for the open position. When the valve is fully open, operating motor is cut off by integral switch. While the operator is energized, current consumption drops to a minimum. Valve action can be reversed. Sizes from 2 to 72 in.

Rivett Turret Lathe

A turret lathe featuring toolroom precision is now offered by Rivett Lathe & Grinder, Inc., Boston, Mass. By adding power and speed to the basic accuracy of its cabinet lathe, Rivett has developed this 9-in-swing machine for fast production of small duplicate parts to interchangeable limits.

Well-grouped controls permit instant selection of variable cutting speeds from 90 to 3750 rpm, and a convenient automatic chuck closer with switch, controls spindle drive, and brake. Spindle is dynamically balanced on superprecision grease-sealed ball bearings, mounted to incur no thermal stresses.

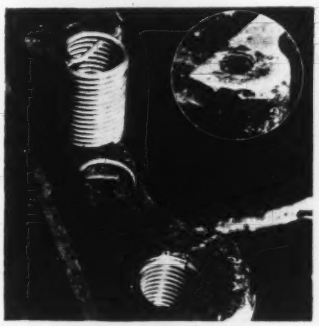
Newly designed collets have doubled bearing spacing for greater precision and increased gripping power. Draw-in collet capacity is $1\frac{1}{8}$ in., on long taper key-drive spindle nose. Capacity of stationary collet is $\frac{7}{8}$ in., and closing action is accomplished without lateral movement in the spindle preventing scarring of stock. Self-aligning slide rest automatically squares itself with line of centers. Double-bevel steel ways, hardened and ground, provide positive centering action.

Automatic indexing turret revolves on ball thrust bearing with constant preload opposed by taper roller bearing preventing vertical error; the locating and locking index pin engages jig-ground holes on index plate, preventing lateral error.

• Keep Informed

Helical Thread Repair Inserts

Stainless-steel helical-wire thread inserts are speeding thread-repair operations on heavy electric motor castings at a large eastern repair shop. These thread inserts are manufactured by Heli-Coil Corp., L. I. C., N. Y. New threads, said to be stronger and more wear-resistant than original threads, are installed in 80 per cent less time than conventional repair methods require. Cost savings are reported as high as 60 per cent.



New threads are installed by: (a) Drilling out the old $1^1/_2$–6 threads shown in the inset, top right of accompanying photo; (b) retapping with $1^1/_2$–6 Heli-Coil taps; and (c) installing a $1^1/_2$–6 stainless-steel Heli-Coil thread insert with an inserting tool to bring the hole back to original threaded size. These thread liners resist abrasion and eliminate seizing, galling, and corrosion.

The unmounted thread insert, top left, with a free diameter slightly larger than the receiving hole, is self-locking when positioned in the hole, yet may be removed with another tool. The installed insert, bottom center, is properly positioned below the casting surface and has had its notched inserting tang removed with a tang break-off tool.

Because these precision-formed coils of diamond-shaped 18-8 steel wire provide higher thread-flank engagements, the threads in the repaired hole can safely withstand 20 to 30 per cent higher loads than the original threads.

Air Circuit Breaker

A new low-voltage air circuit breaker, the DB-50, has been added to the line of DB breakers manufactured by the Westinghouse Electric Corp. With an interrupting capacity of 50,000 amp, the DB-50 joins the DB-15 and DB-25 for application in low-voltage industrial and commercial power distribution systems, central-station auxiliaries, motor starting duty, and similar uses.

The DB-50 features a new air-delayed series over-current tripping device, with all elements completely adjustable, that provides long-time delay on overloads and instantaneous tripping of fault currents. For use on feeder and back-up breakers, over-current trip units including both a long-time delay and short-time delay element can be specified, thus providing for selective operation on fault.

Rated at 600 volts a c, 250 volts d c, the DB-50 has a continuous rating of 100 to 1600 amp. It can be operated manually, or by either d-c solenoid or a-c Rectox solenoid.

Continued on Page 44

rapidly duplicated with di-acro

HYDRA-POWER BENDER

At last—a PRODUCTION BENDER that "BENDS THEM ALL" — tubing — angle — channel—extrusions—moulding—strip stock—bus bars—and of course, all types of solid materials. U-Bolts and Eye-Bolts are just two examples of the shapes that can be rapidly produced in one operation with this hydraulic power bender.

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why carry three spares when one can do the trick?

Years ago a motorist loaded down his car with plenty of spares. He had to. Tire design was such that blowouts were commonplace — and expected.

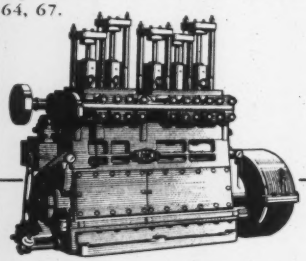
But look at the trim modern car! One spare is plenty—and it's seldom used.

Similarly, not so long ago a company had to stock three or more sets of spare parts to cover reciprocating pump needs. Today, the same company—by using Aldrich 5″ Stroke Direct Flow Pumps—inventories but *one* set of spares to cover a 100 to 275 hp range.

Construction of Aldrich Direct Flow Pumps features wearing parts —valves, plungers, packing, crossheads, wrist pins, etc.—interchangeable within *each* stroke series. This covers 3, 5, 7 and 9 plunger units for the 5″ series ranging up to 275 hp, or for the 6″ series, from 300 to 900 hp. Rather than enlarge the stroke, Aldrich added cylinders to increase pump capacity.

To what advantage?—You benefit through interchangeability, fewer spare parts to tie up money and space, simplified maintenance, and better protection against shut-down . . . all made possible through greater standardization and improved design.

Applications where you'll find Aldrich Direct Flow Pumps saving maintenance time and dollars include: hydraulic systems for press operation; plastic and rubber molding and extrusion; steel mill descaling, and other uses in the petroleum and chemical industries. . . . Write for Data Sheets 64, 67.



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• Keep Informed

High Temperature Mechanical Seal

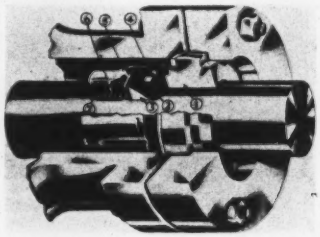
A new, improved mechanical seal, has been announced by Crane Packing Co., Chicago, Ill.

The new seal, designated as the Type 9 mechanical shaft seal, performs effectively under severe temperature (up to 500 F) and corrosive conditions.

The Type 9 seal incorporates a flexible ring molded from the remarkable new plastic, Teflon, enabling the seal to combine the chemically inert properties of Teflon with the flexibility and positive sealing components essential to effective mechanical sealing.

The Type 9 Seal has been designed for service on various rotating shaft applications, such as centrifugal pumps, turbines, positive displacement pumps, and agitators.

Construction of the seal is shown in the cutaway drawing.



The set-screwed metal retainer (7) provides a positive drive from shaft to carbon sealing washer (2) through dents (4) which fit into washer notches. An effective seal between the shaft and washer is insured by the precision-machined Teflon wedge ring (3) which is preloaded by the action of multiple springs (6). Spring pressure is uniformly distributed by a metal disk (5). The lapped raised face of the rotating sealing washer (2) mates against the highly lapped face of the stationary seat (1) to provide a positive leak-proof seal with minimum running friction between the vertical faces. Spring pressure keeps the faces in constant contact providing automatic adjustment for wear and shaft end play.

A new booklet has just been prepared, describing this seal developed in detail. It can be obtained by writing the manufacturer; Crane Packing Co. Dept. M-25, 1800 Cuyler Ave., Chicago 13, Ill.

Type 5YP- Cathode-Ray Tube

The Instrument Division of Allen B. Du Mont Laboratories, Inc., Clifton, N. J., announces the type 5YP- Cathode-ray Tube designed for low and medium-voltage operation and suited especially for wide-band equipment.

For this category of operation, it is said to be the most sensitive tube commercially available. One inch of vertical deflection can be obtained with an input to the deflection plates of 12 volts peak, per kilovolt of accelerating potential applied to the second anode. And the type 5YP- employs an intensifier for increased brightness and smaller spot size.

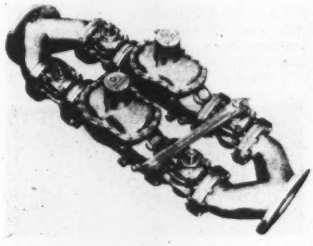
The elongated, vertical-deflection plates of the type 5YP- are similar to those of the Du Mont Type 5XP-, high-voltage, high-sensitivity, cathode-ray tube. These plates of the type 5YP- have been spaced to provide maximum sensitivity commensurate with distortion-free performance over the 3-in. usable vertical scan of the tube.

• Keep Informed

Compound Meter Manifold

Large water users—laundries, process industries, textile mills, dairies, food and beverage processors, many types of machine shops, and other industrial plants, and major domestic water consumers such as apartment buildings—have long had the problem of proper meter maintenance without costly shutdowns or extra-hour work.

To answer this problem a new compound meter manifold unit has been introduced by the Rockwell Mfg. Co., Pittsburgh, Pa. The manifold assembly consists of two Pittsburgh-Empire single register compound meters in combination with four Nordstrom lubricated plug valves and two 8-in. reducing manifolds, so arranged that for maintenance, one side may be shut down at a time without complete interruption of service.



By isolating one side, a meter can be removed and exchanged for one serviced and calibrated in the shop, while flow continues through the other meter passage. It is also possible, with this assembly, to check-test a meter in place without a break in service. To make such a test, the discharge valve of the meter may be shut off and the test plug in the meter body used for the test run.

The manifold assembly has the same flow capacity—1600 gpm—as the American Water Works Association requirement for an 8-in. compound meter. As a unit, it has a laying length that is within the American Water Works Association standard for a single 8-in. compound meter. Sold as a unit, it is priced below a single 8-in. compound meter, and the complete manifold of meters, valves, and piping weighs 100 lb less than a comparable 8-in. compound meter.

The battery can be handled as a complete assembly or broken down into sections, the heaviest of which is 170 lb.

Explosionproof Mining Motors

A new line of explosionproof mining motors, conforming to the Bureau of Mines Schedule 2E, has been announced by General Electric's Small and Medium Motor Divisions, and are available in ratings from $\frac{1}{2}$ hp through 60 hp at 230, 250, 500, and 550 volts, with stabilized shunt, compound, or series windings.

All frame sizes in the line utilize two stud brush mechanisms. With this construction all brushes are accessible through two large handhole covers in the upper half of the commutator end shield, greatly facilitating inspection and brush replacement. Nonrusting cast bronze handhole covers with heavy integral lugs resist corrosion and do not require special tools for removal. The motors also use a cable gland design which permits cable replacement without removing the end shield or working through the commutator access openings.

Continued on Page 46

when line "feathers" make the feathers fly...

... Switch to Arkwright Tracing Cloth! You can re-ink clean, sharp lines over any erasure without "feathering" or "blobbing" to spoil your work.

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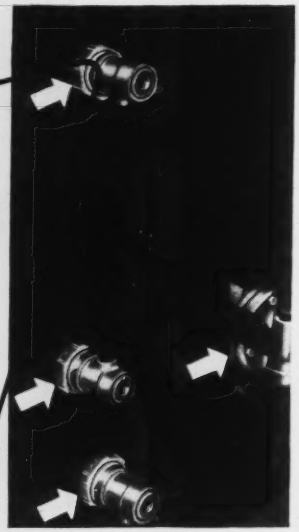
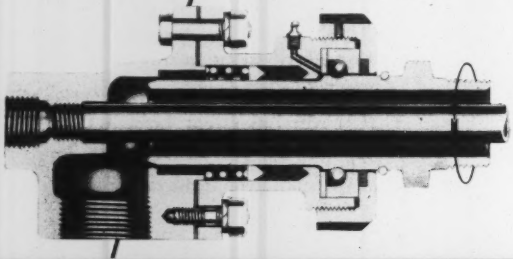
Users REPORT many ADVANTAGES



POWER savings up to 50% . . . long, leakproof service . . . very low requirements for maintenance . . . quick, easy accessibility of parts . . . better temperature control . . . ability to withstand vibration and hard usage — these are just a few of the ADVANTAGES reported by the many users of BARCO REVOLVING JOINTS!

AMERICAN FINISHING COMPANY MEMPHIS, TENN.

User of hundreds of joints on calenders, sanforizers, dry cans and chill rolls, Mr. S. Bernson, Chief Engineer, American Finishing Company writes, "We are well pleased . . . I hope to have entire plant equipped with Barco joints." Formerly, it was considered exceptional to have 75% of joints leak-free. Today, with the change-over to Barco nearing completion, virtually 100% leak-free service is the rule.



IMPROVED TYPE IBR REVOLVING JOINT

Here is the new, *improved* Type IBR Barco Revolving Joint! It is precision-built in *single flow* and *syphon styles* for handling steam, water, air, oil, gas, or chemicals. Note wide spacing between bearings. Inherent low torque is little affected by pressure, speed, or temperature. Light running action minimizes wear, permits free-floating installation. No adjusting necessary. For the complete story, send today for new Bulletin No. 300. *Worldwide sales and service; ask for recommendations.* BARCO MANUFACTURING CO., 1821 J Winnemac Ave., Chicago 40, Ill. In Canada: The Holden Co., Ltd.

BARCO REVOLVING JOINTS

The Only Truly Complete Line of Flexible, Swivel, Swing, and Revolving Joints

FREE ENTERPRISE — THE CORNERSTONE OF AMERICAN PROSPERITY

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Precision Measurements

The larger and more intricate the machines for today's defense production, the greater the cost, both in time and money, of a small error in measurement. Aware of this, the Transformer Division of the Westinghouse Electric Corp. at Sharon, Pa., maintains a precision laboratory that considers a "hair's breadth" hardly more than a rough approximation. Equipped with the latest in precision measuring instruments, this gage laboratory, and the equipment controlled by the laboratory, represent an investment of some $50,000.

The staff of trained technicians not only keeps an eye on the accuracy of company-owned instruments and gages, but also maintains a constant check on the tools personally owned by workers throughout the shop.

While fully 95 per cent of the parts that make up an electric transformer can be measured by ordinary means, an all-important 5 per cent depend on the highly accurate measurements made possible by the laboratory.

For example, patterns and gages too small to be measured by ordinary means are checked in a comparator. A technician projects the greatly enlarged image of a $\frac{1}{2}$-in. template on the comparator's screen. Each thousandth of an inch on the template appears as $\frac{1}{16}$ in. on the screen. The template is held in a small vise in the beam from a brilliant light source.

Vacuum Pump

Kinney Model CVM 3153 is now being offered for applications requiring a small vacuum pump capable of producing high vacuums rapidly and dependably by Kinney Mfg. Co., Boston, Mass. Employing the same oil-sealed pumping system used in other Kinney mechanical vacuum pumps, this new compound pump has a free air displacement of 2 cfm. It is designed for portability: The complete unit, including $\frac{1}{4}$-hp motor, base, and pump, weighs 70 lb. Model CVM 3153 produces McLeod gage absolute pressure readings of 0.1 micron or better, and retains an extremely high percentage of its volumetric efficiency in the low-pressure regions. This new pump is reported to have applications both in research and in production—for lamp and tube manufacturing, for laboratory applications, for backing diffusion pumps, for servicing refrigerating equipment.

• Keep Informed

Shell Machining Practices

A broad service program of furnishing vital technical production data to defense industries to enable such industries to obtain maximum productivity with minimum tooling in the manufacture of products for the armed services, has been launched by Carboloy Co., Inc., Detroit, Mich.

First step in the program has been the accumulation by a staff of Carboloy engineers of all currently available data on the machining of shell and compiling this data in a complete kit for the use of manufacturers who either already have shell-production contracts or who are or may be bidding on such contracts.

Since the shell-machining program includes data on the latest practices as developed by individual companies or in U. S. Arsenals, it is considered by Carboloy as being of a restricted nature and distribution is being closely controlled. Each kit is registered. Although the kit itself—weighing in excess of 5 lb—is remarkably complete, containing data not only on feeds and speeds, tool application and grinding, tool design and brazing, but also on tool layouts and methods of insuring maximum tool conservation, the service program to shell producers does not end here.

As rapidly as new developments in shell-machining practices and equipment become available, supplementary data will be furnished to all holders of registered kits.

In general, kits are made up to suit the needs of the individual producer. There is a basic kit containing data on World War II practices and general information applicable to the machining of all sizes of shell. With this, as the case may be, goes specific information on the practices for different shell sizes. At the present time 90, 105, 120, and 155-mm shell are already covered in this manner.

In order to control distribution, no kits will be mailed on request. Where a company already has a shell contract or where a company has been "cleared" by Army Ordnance to bid on shell contracts, a registered kit will be delivered to the company directly by Carboloy field engineers. In addition, supplemental data, as issued, will be available only to holders of registered kits.

The company already has underway compilation of data on machining of other defense products, each of which is to be handled in a similar manner.

In each case, important consideration is being given to ways and means of reducing consumption of carbide tools to the minimum by insuring maximum effectiveness of carbide tool use where such tools are required.

3-Way Freight Truck

A new battery-operated freight truck for use in plants as a pick-up or delivery truck is being manufactured by the Market Forge Co. of Everett, Mass.

Called the Load-Mobile, the Marforge truck features 3-way operating positions which provide the utmost safety, comfort, and maneuverability. The operator can either sit facing away from the load—which is the normal position; face the load—for narrow passages; or stand on the special step provided for easy access on and off the truck. This is useful for short hauls.

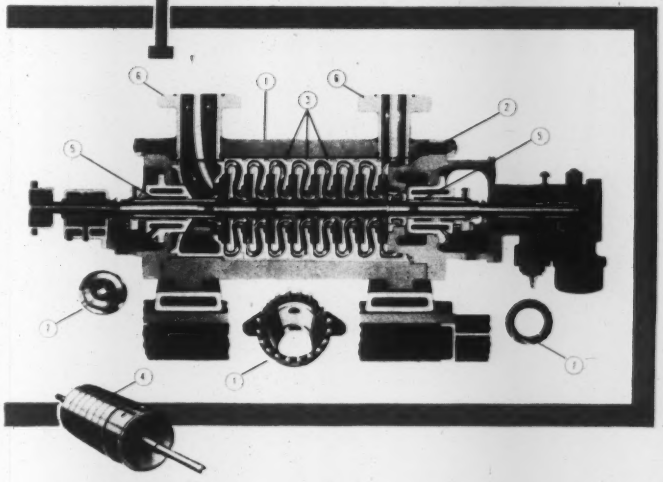
The Load-Mobile freight truck is said to handle every trucking job faster and easier and give high efficiency at low operating cost. Large capacity cushion rubber wheels with sealed ball bearings assure minimum drain on the battery.

Made in two models—3000 lb and 5000 lb

Continued on Page 48

THE STORY OF TOUGH PUMPS FOR TOUGH JOBS

BY Pacific PUMPS, INC.



PART ONE . . . *Time 1926*

The tough job—pressure 2100 psi—temperature 245°F.—
The tough pump.
(1) One-piece cylindrical cast steel case.
(2) Ring Type pressure joints.
(3) Internal joints—metal-to-metal—no bolting.
(4) Unitized internal assembly—assembled outside case.
(5) Suction Pressure on both Stuffing Boxes.
(6) Suction and Discharge Nozzles on Heads.

PART TWO . . . *Time 1927*

The job gets tougher—temperatures rise to 850°F.—
The pump gets tougher.
(1) Cylindrical Case made from Steel Forging.
(7) Impellers, Diffusers and other parts of unitized assembly made from Chrome Alloy Steel.

PART THREE . . . *Time 1931-1951*

Refining a tough—without loss of toughness.
1931—(6) Suction and Discharge Nozzles made integral with case.
1932—(1) Line bore of case with Chrome Alloy by Fusion Welding.
1933-1951—Mechanical, hydraulic and metallurgical research and experience make a refined "Pacific Tough" available for the "Toughest Job"

For Details—Bulletins 106 and 109

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

BF-12

STEP RIGHT UP AND GET YOUR PRINTS ON TIME*
* Today's Bruning "93" can make up to 105 square feet of black-and-white prints per minute.
SPEED TO SPARE!
EASY OPERATION!
EMITS NO FUMES!

Outgrown your present black-and-white print equipment? Meet today's Bruning—it makes other machines look slightly horse-and-buggy. It's the talk of the trade!

TALK ABOUT VOLUME...with a Model 93 Bruning you can print up to 105 square feet per minute! And that's *finished* prints – prints that come out flat, dry, neatly stacked, and ready for immediate use.

TALK ABOUT EASY OPERATION... since Bruning BW machines *use no vapors and emit no fumes*, they require no special exhaust installation. You merely connect them to your electrical circuit and you're ready to make prints. And when a Bruning machine is rolling, all you do is set the desired speed and feed in the paper. That's all. No trained operator is needed.

TALK ABOUT EASY MAINTENANCE...all essential bearings are permanently lubricated—also self-aligning. The adjustable speed drive is a patented, stepless transmission that runs for years without attention. Parts that do require occasional attention are accessible in minutes.

TALK ABOUT FLEXIBILITY... Bruning BW machines can handle *any* black-and-white print jobs, and six different models offer a complete range of speeds and capacities. Too, there are 85 varieties of Bruning sensitized papers, films and cloths – far more than any other manufacturer offers.

SEE FOR YOURSELF the speed and ease of operating a Bruning BW machine. It's an eye-opener even if your present equipment is just a few years old. A complimentary demonstration, or our explanatory booklet, is yours for clipping the coupon.

The revolutionary, new BW Copyflex model.

BRUNING

Specialists in copying since 1897

CHARLES BRUNING COMPANY, INC.
Dept. B-81 100 Reade St. New York 13, N. Y.
☐ Please send me your free booklet A-1053A.
☐ I would like to see a Bruning BW machine demonstrated.
Name _____ Title _____
Company _____
Street _____
City _____ Zone _____ State _____

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capacity, the Load-Mobile travels at 3.5 to 4.0 mph with no load. With full load, the 3000-lb truck goes at 3.0 mph and the 5000 lb at 2.5 mph.

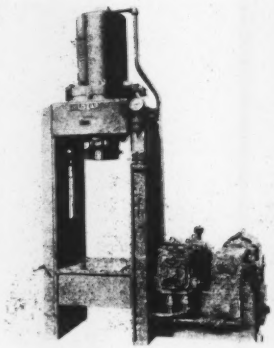
The freight truck may also be used as a tractor and can be furnished with a suitable coupling when necessary.

The Materials Handling Division of the Market Forge Co. also announced the addition of a fork truck to its line of rider-driven, self-propelled materials-handling units.

The new fork truck was especially developed to meet the needs of small and medium-sized plants.

Extruding Pencil Leads

Designed essentially for extruding pencil leads, the Oilgear Special 75-ton two-column press, made by The Oilgear Co., Milwaukee, Wis., is also ideal for extruding ceramics, graphite, crayons, etc. Positive, fine, steady, variable ram speeds and high approach and return speeds are provided by the Oilgear FAC-10304-H feed pump. An Oilgear DS-411 variable delivery pump, mounted on a common oil reservoir, greatly extends the extruding speed range. Each pump is driven by a separate direct-connected electric motor. The feed pump can be used alone when using ram feeds up to 2.2 ipm. Operation is as follows: Operator moves control lever to "traverse down" position. As ram approaches work, lever is released and linkage automatically moves lever to "extrude" position. Ram continues downward at extruding speed until adjustable collar on control rod strikes a pawl which releases linkage and allows it to move control lever to "traverse up" position. Ram moves up until it strikes adjustable collar and linkage moves lever to "neutral" position. Any function, during any part of cycle, can be selected at will. Ram speeds, ipm: extruding, "FAC" only, 1 to 2.2; both pumps, 2.2 to 12; traverse down, "FAC" only, 22; both pumps, 22 to 33; traverse up, 46. Stroke, 18 in. Daylight, 36 in. Between columns, 24 in. Front to back, 24 in. Table height, 24 in. Net weight, 7480 lb.



Crane Cab Cooler

New type equipment for air conditioning the cabs of cranes operating in high temperatures or in atmospheres contaminated by toxic and noxious gases or dusts, has been developed by Dravo Corporation, Pittsburgh, Pa.

With the new equipment, known as the "split-type crane cab cooler," no ductwork is needed for installation because the cooling section is installed in the cab itself and the

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larger condenser section is placed outside on the crane in any convenient location.

Like other models of Dravo crane cab coolers, the new split-type unit provides constant, year-round ventilation, filters the air to remove dust, dirt, and fumes, cools the air in the summer and, if necessary, heats the air during the winter.

The cooling section, which goes into the cab, is housed in an attractive aluminum-finish cabinet. There is ample room for the unit in most crane cabs. The only connections between it and the condenser unit outside the cab are power lines and refrigerant piping.

Thermostatically controlled, the split-type crane cab cooler will maintain a temperature of 80 to 85 F when the outside ambient temperature is 175. During the heating cycle, the unit keeps the temperature in the cab at 68 to 75 with an ambient temperature of zero outside.

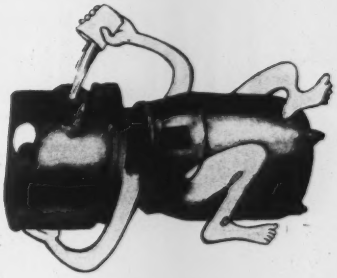
Portable Gasoline Hammers

Introduction of improved models of Barco portable gasoline hammers, featuring new ignition, greater portability, and increased operating convenience, is announced by Barco Manufacturing Co., Chicago, Ill. The new hammers are distinguished by a simplified arrangement of parts made possible by use of a new and highly compact ignition coil-vibrator-condenser assembly which is now located in the right hammer handle.

This new coil-vibrator-condenser assembly weighs only a few ounces. It replaces a coil several times heavier and larger which formerly was a separate part connected to the hammer by heavy cable. By locating the coil in the handle, the length of the high tension lead is reduced from 10 ft to about 5 in. thereby making for better ignition. Also, the vibrator is a continuous vibrating type, not dependent on time point contact, which insures a faster initial spark and quick, easy starting under all weather conditions. The coil, vibrator, and condenser are of sealed-type construction, which does not permit field adjustment or unauthorized tampering, and are easily replaceable as units. The ignition switch is a new toggle type, also conveniently relocated in the handle.

This hammer is unique in that it requires no auxiliary equipment or power source other than an ignition battery, thus making it completely portable and suitable for use at any location with a single operator and no other attendants. The hammer is air cooled and

Continued on Page 51



ONLY new Goulds Self-Priming Pumps Give ALL 5 Important Advantages

1. **Absolutely no valves**—There are no valves of any kind in these pumps—nor are any needed in installation. Liquid can drain out of discharge and suction line through pump without affecting priming abllity.
2. **No recirculation**—Liquid does not recirculate after completion of priming action.
3. **Top-notch efficiencies**—Efficiencies in these pumps are comparable to quality straight centrifugal pumps.
4. **Positive fast-acting self-priming**—Self-priming is similar to priming ability of positive displacement pumps.
5. **Small compact priming chambers**—No large or bulky priming chambers mean small, compact units at low cost.

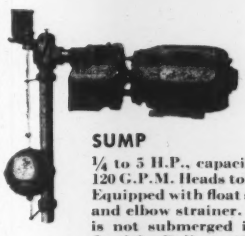
SELECT THE PUMP YOU NEED FROM THIS COMPLETE LINE

INDUSTRIAL

¼ to 5 H.P. ratings, open and closed impellers. Capacities to 120 G.P.M. Heads to 135 ft., suction lifts to 25 ft. Flexible coupling, or close-cupld motor drive. Send for Bulletin 636.1.

PORTABLE

Compact, lightweight, with gasoline engine. Capacities to 58 G.P.M. Heads to 25 ft. Send for Bulletin 639.1.

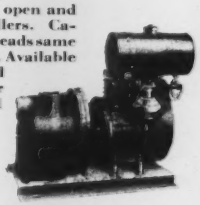


SUMP

¼ to 5 H.P., capacities to 120 G.P.M. Heads to 135 ft. Equipped with float switch and elbow strainer. Pump is not submerged in pit. Send for Bulletin 627.

GASOLINE ENGINE DRIVEN

1½ to 5 H.P., open and closed impellers. Capacities and heads same as Industrial. Available in close cupld only. Send for Bulletin 638.1



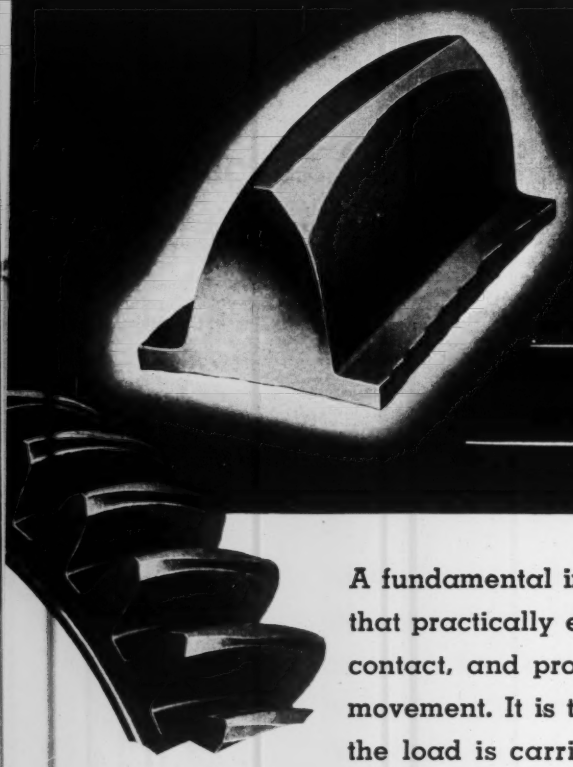
For complete information contact your nearest Goulds representative or write Pump Headquarters, Seneca Falls, N.Y.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

THE AMERIGEAR* FULLY CROWNED TOOTH

*Trade Mark Registered



A MAJOR IMPROVEMENT IN GEARING

A fundamental improvement in gear tooth design that practically eliminates all "end tooth and tip" contact, and provides greater freedom of axial movement. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum and permits greater load-speed capacity. The result of a program of continuous research and development, keyed to achieve higher efficiency in the transmission of power, the *Amerigear Fully Crowned Tooth* may be utilized in solving a wide range of special power transmission problems other than those common to gear-type couplings in which it is now incorporated. A folder on the Amerigear Fully Crowned Tooth is available on request.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth • Sales Offices in Principal Industrial Centers

ERIE, PA., U. S. A.

AFFILIATE OF J. A. ZURN MFG. CO. • ERIE, PA., U.S.A.

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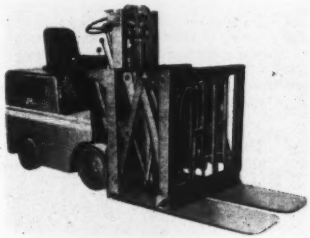
gets its power from a single, two-cycle, full floating piston. Fuel used is regular grade motor gasoline to which lubricating oil is added. Normal fuel consumption is one quart of gasoline per hour, operating continuously.

Standard models include Model J-2, weighing 72 lb, and heavy-duty Model H-6B, weighing 89 lb. Both deliver up to 1550 strokes per min and differ only in size and weight.

"Pul-Pac" and Pusher Devices

New Pul-Pac and Pusher devices for 3000- to 5000-lb "Carloader" fork trucks, which feature pantograph-type linkage, more powerful piston and shorter stroke, are now available for both gas and electric 2000-lb capacity Clipper lift trucks, it was announced by Clark Equipment Co., Industrial Truck Division, Battle Creek, Mich.

Unit loads, assembled on relatively inexpensive carrier sheets rather than on conventional pallets, can be pulled onto and pushed off the load-carrying plates with the Pul-Pac device.



The pusher device, similar to the Pul-Pac excepting for the gripping mechanism and carrying plate, is used for unloading operations only. Unit loads can be unloaded directly from the forks or from conventional pallets with the pusher whenever rehandling as a unit is not required.

The pusher will be available for export sale; the Pul-Pac will be released for export sale at a later date.

Record-Reproduce Head

A new multichannel magnetic record-reproduce head has just been announced by the Brush Development Co., Cleveland, Ohio. The BK-1500 series is available from 3 to 14 channels. Design features include balanced magnetic construction with gaps at front and rear. All gaps are in perfect alignment, and individual channels are cast into one integral block of specially selected synthetic resin. The complete assembly is nonmicrophonic and impervious to moisture. Shields and pole pieces are grounded to the housing. The head has a channel width of 0.050 in. with center-to-center spacing between channels of 0.125 in. The gap is 0.0005 in. Maximum output level at 1000 cps and 7.5 in. per sec tape speed is 0.002 volts rms.

Forged-Steel Gage Valve

Edward Valves, Inc. of East Chicago, Ind., builders of forged and cast-steel valves for the petroleum producing and refining, chemical processing, power, marine, industrial, and other technological fields, now offers the additional design of male inlet and female outlet in Edward forged-steel gage valve series in the popular half-inch size.

Continued on Page 52

STOP COSTLY SHUTDOWNS DUE TO COUPLING FAILURE

THE PROVEN GEAR-TYPE COUPLING WITH FULLY CROWNED TEETH

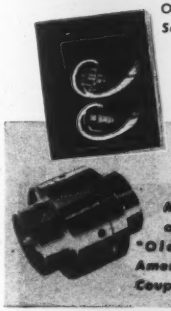
Teeth designed and formed to accomplish tight fit on the crown, as well as on the flanks. Teeth that reduce backlash to a minimum and operate with relatively constant stresses on all teeth simultaneously in all positions; provide freer axial movement; prevent end tooth and tip contacts; assure quiet performance; enlarge load and speed capacity, and give so much more protection than ever before against downtime. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give relief from coupling failure grief. Amerigear Couplings are available for all standard shaft sizes and the widest range of speed and load capacities. Catalog available on request.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth
Sales Offices in Principal Industrial Centers

ERIE, PA., U. S. A.

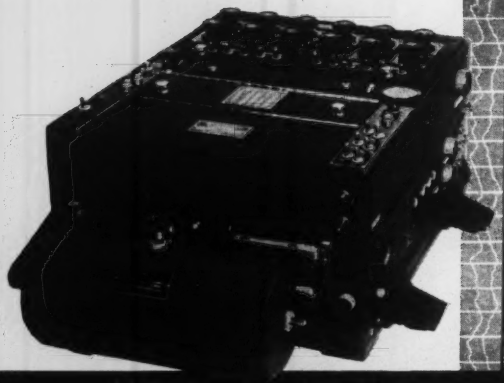
AFFILIATE OF J. A. ZURN MFG. CO.



Manufacturers of the original "Oldham Type" American Flexible Coupling.

AMERICAN FLEXIBLE COUPLING CO., ERIE, PA., U. S. A.
Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

Name ..... Title .....
Company .....
Address .....
City ..... State .....
Please attach to your business letterhead. Dept. ME



the *NEW* S-8 Oscillograph

Here, in a versatile instrument of advanced design, are all the things you need for complete oscillographic recording. The Hathaway Type S-8 Oscillograph, which has long been the standard of oscillographic recording, has been improved to meet the rapidly expanding demands of modern research. Whether your measurement problems are simple or complex, the NEW Type S-8 Oscillograph has the inherent capabilities necessary to measure vibration, pressure, acceleration, and strain with new ease and accuracy.

The newest features include:

QUICK-CHANGE TRANSMISSION *fully enclosed with gears running in oil* **to provide instantaneous selection of 16 record speeds over the range of 120:1**

CHART TRAVEL INDICATOR provides continuous indication of chart motion. Operator knows instantly by flashing lamp if anything should happen to interfere with chart motion

FULL-RESILIENT MOUNTING FOR MOTOR AND TRANSMISSION isolates all possible vibration and makes possible the use of modern super-sensitive galvanometers

NEW GALVANOMETER STAGE accommodates *all* Hathaway galvanometer for recording milliamperes, microamperes, or watts

NEW RECORD-LENGTH CONTROL AND NUMBERING SYSTEM designed for long, trouble-free service under all kinds of ambient conditions

All the other valuable features are retained, such as

PRECISION TUNING-FORK-CONTROLLED TIMING SYSTEM produces either 1/10-second or 1/100-second time lines across sheet

WIDE RANGE OF GALVANOMETER TYPES AND CHARACTERISTICS provide for almost any recording requirements. Natural frequencies to 10,000 cps. Sensitivities to 50,000 mm per ma, single and polyphase watts

DAYLIGHT LOADING AND UNLOADING RECORDS TO 200 FT. IN LENGTH, width to 10 inches

SIMULTANEOUS VIEWING AND RECORDING

AUTOMATIC BRILLIANCY CONTROL

12 TO 92 ELEMENTS

Whatever your needs may be, investigate the NEW Type S-8 Oscillograph and its 170 types of galvanometers — the most versatile equipment in existence for general-purpose applications.

WRITE FOR BULLETIN 2B1-K

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

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The new model modification is otherwise identical in design detail to the Edward gage valves with female connections on both ends which serve Christmas trees, meter, dead-end, instrument and other small pipe lines, pumps, vents, separators, Diesel and gas engines, original equipment, etc.

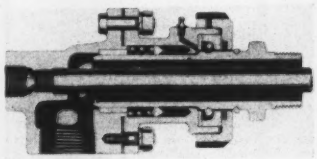
The new gage valve requires no nipples. The male inlet is an integral part of the forged-steel valve body offering greater strength and soundness. The wall thickness of the male inlet is extra heavy for high pressures and provides greater protection against breaking off or rupturing.

The globe design is designated as Edward Fig. 152J and the angle as Fig. 153J. Ratings are 4000 lb at 150 F or 600 lb at 750 F.

Revolving Joint

Introduction of a new, compact, improved type of revolving joint for use in making piping connections to drum-type dryers, rolls, calendars, and other rotating equipment is announced by Barco Mfg. Co., Chicago, Ill. Designated as Type IBR, the new joint is characterized by extremely low torque, thus offering substantial power savings. Models are available for handling steam, oil, air, water, gas, and chemicals.

The rotating portion of the joint consists of a special precision-machined and heat-treated steel tube which screws into the hub of the drum or roll. The nonrotating portion of the joint is ball-bearing mounted on this tube. The specially designed ball bearings carry the load of both radial and end thrust. Use of a sleeve type pilot bearing at the end of the rotating tube insures alignment of the joint and provides a long bearing against twisting or cocking. Self-adjusting, self-sealing chevron type packing carried under light spring pressure provides a long life seal on the rotating tube. Low maintenance cost is assured since these new joints can be serviced, usually without even removing the joint from the roll. New packing can be installed in a matter of minutes, saving "downtime" as well as repair costs.



The new Type IBR joints are built for 150 psi, steam, or 200 psi, hydraulic, and also for vacuum service. They are recommended for speeds up to 500 rpm, steam, or 750 rpm, hydraulic, and for temperatures up to 450 F, depending on packing specified. Standard sizes range from $\frac{1}{2}$ to 2 in. Body types include both single and syphon or two-way flow models with straight and angle connections.

Electric Power Industrial Truck

A new model electric-power industrial truck announced by Elwell-Parker Electric Co., Cleveland, Ohio, combines low truck weight with relatively high load capacity. This is useful in many materials-handling operations, especially in older types of loft buildings and factories where weight restrictions apply to floors, ramps, and elevators.

The basic truck is similar to that of Elwell-Parker's high-lift platform trucks. The load-supporting member is attached to the elevating truck mechanism the same as in platform trucks. In place of a platform

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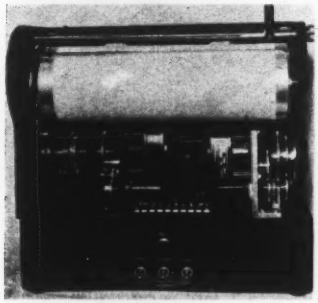
however, two reinforced alloy steel arms or forks extend forward the usual length of a platform. The forward wheels are only $6\frac{1}{2}$ in. diam and the arms in lowered position come outside and nearly flush with the top of the wheels.

This arrangement provides for low under-clearance in various type skids, as compared with 12 in. generally required for standard platform trucks. For high-tiering the truck may be equipped with a fork, the tines of which come below the top level of the wheels. The base tier rests on wood or steel skids only 8 in. high, enabling the forward wheels or "roller-outrigger" to clear them. Upper tiers are handled on pallets, runners, or cleats in the usual manner of fork trucks.

These trucks are built in several sizes with load capacities ranging from 4000 to 10,000 lb. Low truck weight plus high load factors mean more speed, volume, and economy in handling materials.

"X-Y" Type Recorder

A new self-contained and portable strip-chart recorder of the "X-Y" type for plotting automatically on rectangular co-ordinates the simultaneous relationship between any two variables that can be made to actuate Microformers, is announced by Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.



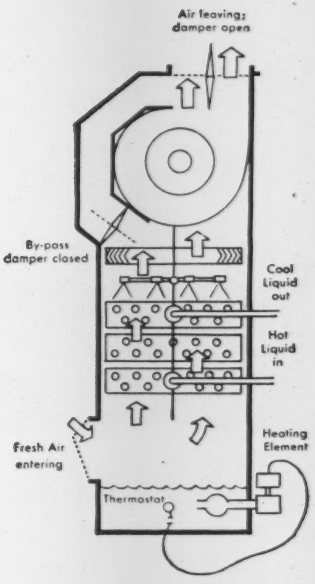
The recorder, identified as the MD-2, is similar in size and appearance to other models designed for attachment to B-T-E testing machines. It may also be used with any testing machine in which hydrostatic pressure in either the loading or weighing system is proportional to load applied to the specimen.

Microformers are miniature variable transformers having usable core movements of 0.120 in. Displacement of the core of an external, sensing Microformer upsets the balance of a self-balancing bridge of which it and the recorder Microformer are a part. The unbalanced signal is amplified by an electronic circuit and drives a servo-motor. This moves the core of the recorder Microformer to the same position as the external core, thus re-establishing electrical balance, and operating the recorder drum or stylus.

Sensing Microformer core movements of 0.03 in. and 0.06 in. can produce full-scale (10 in.) displacement of the stylus and core movements of 0.03 in., 0.06 in., and 0.120 in. can produce drum rotation of 10 in. Each of the recording elements, when used with an external Microformer of standard precision type, has a recording sensitivity of 0.000015 in. Movement of the external Microformer core can be recorded to an accuracy within 0.2% of the recorder scale range. Full-scale 10-in. response of the stylus across the chart can be obtained in approximately 6 sec on the

Continued on Page 54

NIAGARA Aero Heat Exchanger



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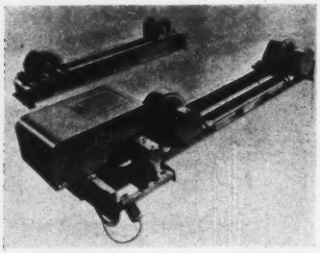
full-scale range, and in approximately 3 sec on the half-scale range. Full-scale 10-in. rotation of the chart can be obtained in 20 sec on all three ranges. Higher speeds may be obtained on special order.

The recorder dimensions are approximately 14 × 10 × 13 in. and it weighs 50 lb.

Newly Designed Turning Rolls

Since turning rolls are needed to weld large cylindrical vessels, tanks, and drums, Worthington Pump and Machinery Corp., Harrison, N. J., has developed and improved both its motor-driven rolls and idler rolls.

With rubber-tired rollers, the model 75PR turning roll has turning capacity of 75 tons, the carrying capacity of which is distributed among three units—one power roll and two idler rolls, each having a 25-ton capacity. With steel rollers, its turning capacity is increased to 150 tons. Here, the carrying capacity is distributed among six units—one power roll and five idler rolls, each with a capacity of 25 tons.



The motor-driven rolls are driven through an enclosed variable speed unit, having a range of speeds to meet individual job requirements. Means are provided to change the center-to-center distances of the rollers for handling work of various diameters. The rollers are mounted upon alloy steel dead shafts subjecting the shaft to bending stress only. The shaft is mounted in the roller upon tapered roller bearings with provisions for adjustment. The drive between the roller and the worm gear box is through alloy steel spur gears enclosed with a guard to protect the gears and to keep them free from slag and dirt.

The Model 75IR idler roll is mounted upon a self-aligning pillow block and equipped with shaft and roller as an integral part. Its fabricated steel rollers can be either plain or rubber-tired.

The base upon which these rollers are mounted is of an extremely rigid structure which is ribbed and cross-braced for additional strength.

Air Conditioning

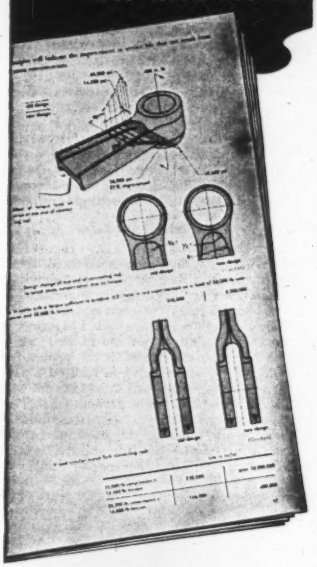
Three tall new buildings being built in Pittsburgh, Pa., will be completely air conditioned with the largest Conduit Weathermaster installation in the world, it was announced by Carrier Corp., of Syracuse, N. Y.

Two of the buildings will be 20 stories high, and the third 24 stories, providing a total rentable area of some 850,000 sq ft. Completion is scheduled for 1952.

Approximately 6000 Weathermaster room units will be installed—about 50 per cent more than the total for the United Nations Secretariat building, the largest previous installation.

The air-conditioning system has been so devised that no mechanical equipment will be needed between basement and penthouse in

WHAT ABOUT STRESS RAISERS?
This book gives the answers..



How to avoid the localized stresses which start failure is a basic problem of design. This 72 page booklet analyzes many good and bad features of design. It also deals with problems of steel selection and treatment from the viewpoint of the design engineer —instead of the metallurgist.

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any of the buildings, thereby making more space available for rental purposes.

Use of more than 12 miles of small conduit, carrying conditioned air under pressure and at high velocities to all outside rooms, will substantially eliminate bulky ductwork and provide a further saving in ceiling heights and floor areas.

All refrigeration for the air conditioning will be centrally located in the basement. Three giant Carrier centrifugal refrigeration machines, among the largest of their kind ever built, will be installed. Rated at 1500 tons each, they will be capable of providing a total cooling effect equivalent to the melting of 9,000,000 lb of ice each 24 hr.

Weathermaster outlets will be furred into the walls under the windows, both facilitating any desired re-arrangement of partitions to suit the desires of tenants and allowing individual control of indoor climate in all outside rooms.

15,000-Lb Ford Truck

Yardlift-150, a pneumatic-tired fork truck for out-of-doors handling of 15,000-lb loads, has been added to its line by the Clark Equipment Co., Battle Creek, Mich.

Thoroughly tested in typical big-load handling operations, the Yardlift-150 is described as ideal for use in lumber mill yards; in the storage yards of steel mills, steel warehouses, and fabrication plants; in automotive body plants and similar installations; in

yards of waste materials dealers handling scrap metal, paper, etc.; in large building supply yards; for heavy moving, rigging, and construction operations; and for many other applications requiring fast, safe handling of extra-large, heavy loads.

Easy steering is achieved by use of a 22-in-diam handwheel which operates an hydraulic power steering-control. In case of engine stoppage, the steering linkage can be operated mechanically. The truck is compactly designed for a minimum turning radius, and its comfortable riding prevents driver-fatigue.

Cathodic Etcher

The availability of new, high-vacuum equipment for cathodic etching and for studying the grain structure of metals by this new technique has been announced by Distillation Products Industries, a division of Eastman Kodak Co., Rochester, N. Y.

The new etcher is based upon cathodic etching principles in which the sample of metal to be studied is bombarded with a glow discharge at certain low pressures. The unit is expected to be particularly useful for studying cold flow lines.

The glow discharge which "etches" the surface of the metal being studied is produced by positive ions passing between an aluminum anode and the sample of metal to be studied

Continued on Page 56

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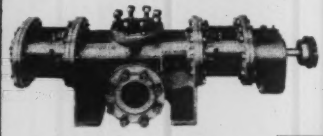

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TYPICAL PURCHASES

A. You buy a cam, lobe, vane or gear type pump for $770. — pay another $2580. for a slow speed motor (if you can get it), or for a faster motor, plus reduction gearing.

TOTAL: $3350.

B. You buy a Sier-Bath Screw Pump for $1570. — but pay only $1860. for a high speed motor — and forget about reduction gearing!

TOTAL: $3430.

CONSIDERATIONS

WITH PURCHASE B you invest your money in the pump — not in the motor. This is possible because Sier-Bath Screw Pumps can be direct connected at high rpm — up to 1800 — and maintain lower liquid velocities than is possible with other types of rotary pumps. The advantages of purchase B over purchase A are: you get a pump that will provide more dependable service, cost less to maintain, and last longer — plus a motor that is smaller, less expensive, but just as serviceable as the $2580. slow speed motor. All told, for $80. more you get a pump worth $800. more!

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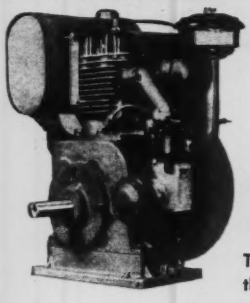

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MODELS	AEH	AFH	AGH	AHH
Bore - - - - - - - - - inches	3	3¼	3½	3⅜
Stroke - - - - - - - - - inches	3¼	4	4	4
Disp. cubic inches - - - - - - - -	23	33.2	38.5	41.3
H. P. and R.P.M. range - - - - - - -	3.9 at 1600	6.0 at 1600	7.2 at 1600	7.7 at 1600
	6.1 at 2600	7.2 at 2200	8.4 at 2200	9.2 at 2200
Net weight in lbs., Standard Engine - - -	130	180	180	180

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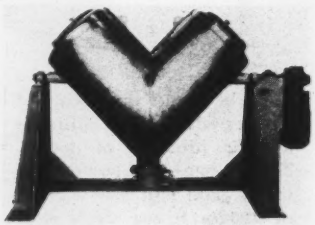
The advantage of this technique lies in the fact that the etching is produced physically rather than chemically, so that there is less danger of forming oxides and other chemical artifacts. Under the bombardment of ions the grain boundaries in metals are attacked at a different rate from the main bodies of the metal crystals, thus in many cases bringing out the crystal shapes and other characteristics of the metal with greater clarity than is possible in an acid etch.

The new etcher will probably be used extensively for pure research in metallurgy, as well as in production sampling. It is expected to prove particularly useful in cases where the metallurgist is confronted with a pressing problem which he hopes he can solve by trying something different from chemical etching, or where chemical etching is difficult.

Twin Shell Blender

The Patterson-Kelley Co., Inc., East Stroudsburg, Pa., has announced the development of the twin shell blender, a unique mixing apparatus for blending dry materials.

The blender consists of two equal-diameter cylindrical shells which are joined to form a V. It rotates around a horizontal axis which passes through the geometrical center. A dust-tight discharge valve is located at the point of the V. Standard access covers with swing bolts and dust-tight gaskets are located at the end of the two legs. If all dust must be avoided while loading, the machine can be set in the inverted V position and fed through the discharge valve at the apex of the V.



Normally the unit is set in an upright position and is charged through either or both the access openings until it is approximately half full.

When blending is completed, the machine is set in the normal vertical V position, and the material is discharged through the discharge valve. If the unit requires cleaning out after each blend, this is accomplished through the access opening. There are no baffles or other obstructions to interfere with easy cleaning or to cause materials to "hang up" and prevent thorough mixing while the unit is in operation.

The Patterson twin shell blender ranges in size from 1 to 250 cu ft capacity. Based on materials of 50 lb per cu ft density, power requirements range from ¼ to 20 hp. Other drives are available for heavier products. The standard motors are of the integral gearhead type with a built-in magnetic brake for close control in "spotting" the unit for charging and discharging.

Improved Flow Interlock

An improved flow interlock, a device which responds to a flow of water to open or close an electrical contact, has been announced by General Electric's Control Divisions.

The new design includes a finer differential, union fittings at both ends, a bronze piston, reduced size and weight, simpler adjustment, and more wiring space.

In operation, the device closes a contact when a flow of water exceeds a preset amount and opens it when the flow falls below the preset amount. Working under this principle, it actually acts like a fuse in a circuit which depends upon water cooling for protection. The interlock can be used as a safety device in many applications, including hot-water heaters, welding units, kitchen waste units, transformer cooling, induction heating, television luminaires, water-cooled dynamometers, etc.

Only one screw adjustment is needed to set the circuit for any flow from $\frac{1}{2}$ to 4 gpm. The flow differential between the cut-in and cut-out of the electrical contact is 0.1 gal max. The interlock does not control the amount of water flow. This can be accomplished, if desired, by installing a throttling or regulating valve ahead of the device.

Electrical rating of the new flow interlock is 10 amps at 120 or 240 volts, a c. Maximum line pressure that the device will withstand is 125 psi.

Light-Capacity Fork Trucks

A completely redesigned line of light capacity electric fork lift trucks was announced recently by the Philadelphia Div., Yale & Towne Mfg. Co. Available in capacities up to 2000 lb, the new trucks feature simplified automotive-type controls, hydraulic lift, and compact size. They are designed to fill the needs of manufacturing companies and distribution concerns who desire the advantages of sit-down operation, combined with a short wheelbase and maneuverability.

The sit-down feature of the new light capacity "Lift King" electric truck is coupled with automotive-type controls—steering wheel, foot acceleration, pedal brakes, and gear-shift-like lifting and tilt controls mounted within hand-reach of the steering wheel. The result is easier truck operator training, less fatigue on long shifts, and greater manipulative precision.

The new trucks are all-steel, electrically welded for strength and weight-saving. The fork carriage and elevating channel travel in upright channels by sealed ball bearing mounted rollers. Side thrust is taken by four thrust rollers which eliminate power losses resulting when elevating channels slide along stationary channels.

The tilting mechanism (the mast can tilt forward 5 deg or backward 10 deg to center the load) is also hydraulicklly operated. It is actuated by two double-acting piston-type cylinders which provide load rigidity.

Expansion-Type Bellows

The manufacture of expansion-type bellows for the absorption of high-frequency vibration and lineal expansion in many types of equipment has been announced by Titeflex, Inc., Newark, N. J. Constructed of convoluted metal diaphragms welded into complete units, the bellows have been tested in many operations over past months and have been found especially valuable for applications involving constant high pressures, corrosive liquids and gases, and extreme temperatures in sealed piping systems. They are available in sizes from 1 to 5 in. ID in various lengths and are manufactured in plain and stainless steels, brass, bronze, Monel, and Inconel according to individual heat, pressure, and corrosion requirements. Height of the convolutions themselves varies according to the degree of flexibility required within a specified length, and wall thicknesses may be increased dependent on pressure requirements. Titeflex bellows may be supplied with or without sleeve liners. In addition to the bellows themselves, assemblies complete with any types of standard or special fittings are available.

Ox Bow Magnet Chain

Two new types of ACCO ox bow magnet chains have been announced by the American Chain Div., American Chain & Cable Co., Inc., York, Pa. They were designed specially for the grueling work of handling materials with electromagnets.

Both the 1-in. and $1\frac{1}{4}$-in. ACCO ox bow magnet chains are made in their entirety from alloy steel and heat-treated to 125,000 psi tensile strength.

A generous bearing surface is provided by the alloy yoke which has a welded holding stud, positioned so as to prevent excessive movement, reducing peening, and battering of connections. Also provided is a zerk or alemite flush fitting for lubrication of the ox bow which reduces friction to a minimum thereby increasing the life of chains and magnets.

The reach of the ox bow can be increased in multiples of two links or $5\frac{1}{2}$ in. on the 1-in. chain and two links or $6\frac{3}{8}$ in. on the $1\frac{1}{4}$-in. chain.

Continued on Page 58

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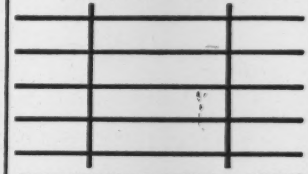
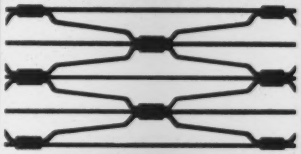


RECTANGULAR MESH — ABOVE
or
RETICULINE MESH — BELOW



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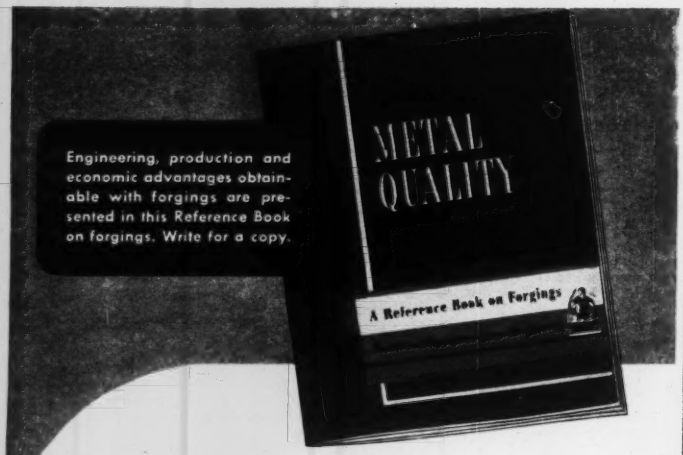
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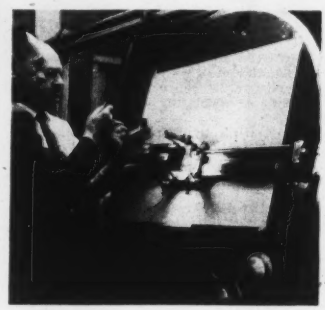
Layout Table

A layout table, accurate to within 0.001 in., is used to produce glass-paper charts for checking the accuracy of finished air-foil sections for turbines at the General Electric Company's Turbine Divisions in Schenectady, N. Y.

Designed and built by turbine engineers at the company's Lynn River (Mass.) Works, the layout table is calibrated on a 32-in. horizontal and vertical scale. Precision layout can be accomplished through microscopic adjustment on both scales.



The entire table surface can be rotated through 360 deg, calibrated in minutes.

When precision layouts made on this table are compared with test samples of actual air-foil sections by means of an "optical comparator" machine, any discrepancy in the foil can be clearly seen, engineers said.

GRS Latex Foam Rubber

The Sponge Rubber Products Co., Shelton, Conn., announces the development of latex foam rubber made of 100% GRS as additional to their existing line of "Texfoam" latex foam items for the furniture industry. The company claims that their new product has satisfactory strength and is essentially free from the odor generally held to be the main objection to latex foams with but a partial content of synthetic rubber. The new compound is said to produce latex foam in the full range of densities and compressions from extremely soft (3 lb per cu ft) to material 20 lb per cu ft, or more. The company alleges a superiority over latex foam made of natural latex in that their synthetic latex foam retains more than 90% of its room temperature flexibility at—40 F, and is still quite flexible at—70 F. This, and the fact that other of their synthetic latex foams can be made of nonflammable and oil-resistant polymers, is held to be of interest to those confronted with military applications.

High-Compression Gas Engine

A new high-compression spark-ignition gas engine has been shipped to Arizona Edison Co., Inc., Ajo Heights, Ariz., by Worthington Pump and Machinery Corp., Harrison, N. J. This new type of Worthington gas engine with Diesel compression is the first of its kind to be installed in Southwestern United States.

Preparing for additional customer demand, Arizona Edison specified a four-cycle engine suitable for 50 per cent increase in power by supercharging at a future date. The present generator and engine auxiliaries are suitable for the ultimate power—720 hp sea-level rating. This high-compression-type engine uses 27 per cent less fuel than the conventional type of spark-ignition gas engine.

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High Vacuum Gasket

Under the trade-mark "Myvaseal" a new synthetic rubber gasketing material with very low vapor pressure has been announced by Distillation Products Industries, a division of Eastman Kodak Co., Rochester, N. Y.

The new material is a soft synthetic elastomer product, has high abrasion resistance, and is moderate in price.

Under standard test conditions, the material has been found to have a lower outgassing pressure than any other material commonly available for this purpose. In most high vacuum systems it does not prevent attainment of pressure down to approximately 10^{-7} mm Hg.

Myvaseal gasketing material is now being used by DPI in parts of electron tube exhaust machines and has resulted in longer-lasting tubes because its remarkably low vapor pressure means higher vacuum with less pumping. The newest in television picture-tube pumping systems and rotary exhaust systems are also being equipped with the new material.

Double-Slide Surface Broaching Machine

Oilgear Co. of Milwaukee, Wis., reports that half-rounds and joint faces with tongues on truck engine connecting rods and caps are finish broached on a twin Oilgear Type XD-50 × 66-in-stroke double slide surface broaching machines at the rate of 760 (380 rods and 380 caps) per hr. Approximately 0.280-in. stock is removed from each surface. All chips are removed automatically from the bases of both machines with a single Hapman rubber flight continuous conveyer powered by a ½-hp 1750-rpm motor and reducer.

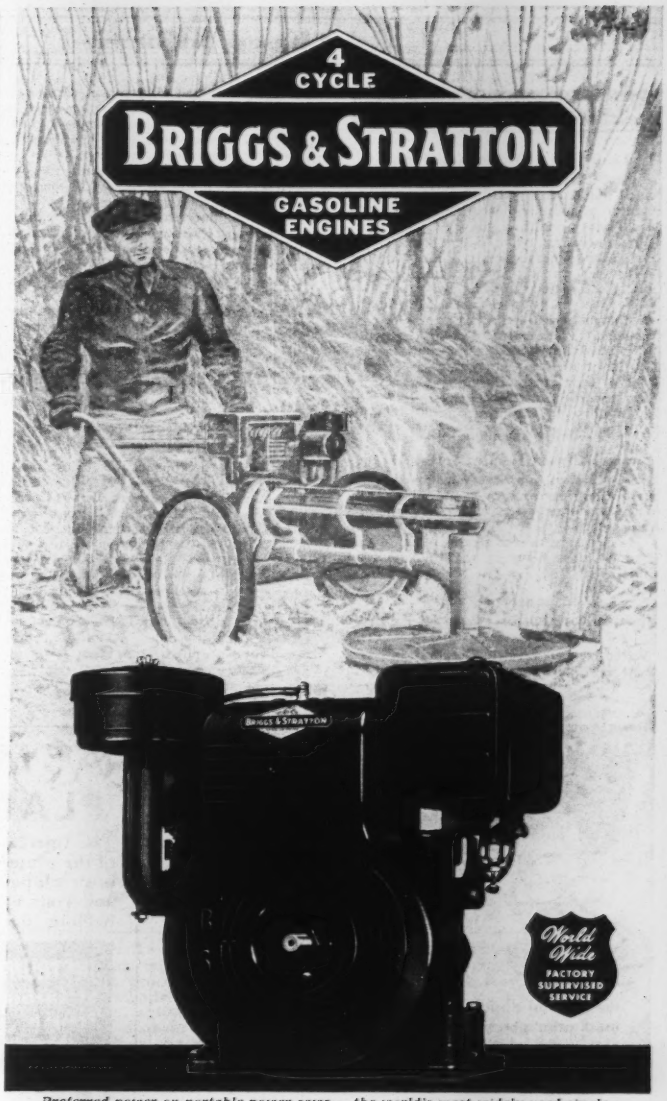
Each machine weighs 52,240 lb, has a normal broaching capacity of 50,000 lb, a peak capacity of 75,000 lb, adjustable cutting speeds for each slide up to 33 fpm, 23 × 77½-in. tool slides, 27 × 21 in. work tables, and an Oilgear Type DX-6011 two-way variable-delivery pump direct-connected to a 40-hp 900-rpm electric motor. A new patented worktable shuttling mechanism in knee bracket locks and preloads worktables in broaching position to resist peak tonnage tool face angular thrust. Pushbutton controls are centralized for ease in operation, piping and wiring systems are simplified, and ways for tool slides and worktables are pressure lubricated.

Drop Hammer

Chambersburg Engineering Co., Chambersburg, Pa., introduced the Ceco-Drop, a new type of gravity drop hammer, a little over three years ago. In February of this year, they completed the one hundredth hammer of this type, of which, as of March 1, 1951, there were 96 in service and 65 on order.

The Ceco-Drop, popularly known as "the boardless gravity drop hammer," was developed by Chambersburg as an improvement on the board drop hammer, which has been one of the company's main products since 1912. In the Ceco-Drop, the ram, instead of being fixed to a board, operating between rollers, is attached to a piston operating in a cylinder. It is raised by air or steam to the top of the stroke, at which point the air or steam exhausts and the ram drops by gravity. Additional advantages claimed are lowered center of gravity, resulting in more accurate die match, more rapid striking action, quicker getaway of the ram after striking, reduction of shock and vibration, and greater safety.

Continued on Page 60



Preferred power on portable power saws — the world's most widely used single-cylinder gasoline engines on hundreds of kinds and types of machines, tools, appliances used by industry, construction, railroads, oil-fields, and on equipment for farms and farm homes.

DEVELOPED through years of building the right power for the toughest service, Briggs & Stratton single-cylinder, 4-cycle, air-cooled gasoline engines assure the best in performance, long life, economy. Briggs & Stratton Corporation, Milwaukee 1, Wisconsin, U. S. A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

• Keep Informed . . .

• BUSINESS CHANGES

Link-Belt to Build New Plant

Link-Belt Co., Chicago, Ill., announces that it has started construction of a modern engineering and manufacturing plant for the production of elevating, conveying, and processing machinery, on a 43-acre site at Colmar, Montgomery County, Pa., on the Doylestown branch of the Reading Railway. Colmar is 3½ miles from Lansdale.

The new plant is designed for efficient straight-line manufacture from the receiving department at one end of an 880-ft-long building to the shipping department at the other end. It will contain approximately 300,000 sq ft of floor space, including a two-story office building and a modern cafeteria. The layout allows for future expansion to double the initial size.

Sarco Midwest Headquarters Moves

The Chicago midwest headquarters for Sarco sales representatives moved recently to new and larger space at 322 West Randolph St., Chicago 6, Ill.

This manufacturer of steam specialties has its main sales office in the Empire State Building, N. Y., N. Y.; the factory is at Bethlehem, Pa.

New Westinghouse Plant to Produce 75,000 Motors Monthly

Westinghouse Electric Corporation's new plant now under construction in Union City, Ind., will be geared to produce 75,000 electric motors a month and will bring approximately $1,500,000 a year into the community in wages and salaries, it was announced recently. The plant will build small electric motors ranging from 1/20 to ½ hp.

Located on 35 acres of ground, the new Westinghouse plant will be 500 ft long and will contain 140,000 sq ft of floor space. The plant will be fluorescent-lighted throughout, will have air-conditioned offices and a medical department, and will be "self-sustaining" because it will not depend on any other location for vital parts, other than raw or processed materials.

At full production, it will have more than 500 employees on the rolls, 60 per cent of whom will be women. All of the employees at the new plant will be hired from the Union City area, except for a skeleton staff of some 10 or 12 supervisors.

Reynolds Building Worlds Largest Gas-Burning Electric Power Plant

To supply the tremendous electric power requirements in its new 80 million dollar aluminum reduction plant at Corpus Christi, Texas, Reynolds Metals Co. is installing 78 internal-combustion engines totalling 256,300 hp and driving d-c generators with a total rated output of 176,000 kw. Using natural gas for fuel, it will be the largest gas-burning engine plant so far built.

One section will contain 40 Cooper-Bessemer Type I.SV., 16-cyl, 3700-hp, 4-cycle engines, each driving a 2500-kw d-c generator. Total output of this group is 100,000 kw. These engines will be approximately 10 per cent more efficient than similar gas engines of a few years ago, since they will employ the modern method of supercharging and air intake cooling.

A second group includes 38 General Motors Model 16-358X 2850-hp, 2-cycle engines, each driving a 2000-kw d-c generator for a total output of 76,000 kw. These engines are of a new design and this is the first installation of these unique modern units.

The power plant will consume approximately 1 million cu ft of natural gas per hr. Some 45,000 gal of lubricating oil is required just to fill these engines.

Mears-Kane-Ofeldt Moves

According to a recent announcement, Mears-Kane-Ofeldt, Inc., will now be located in their recently completed modern factory at Church Road, Upper Merion, Pa. Mail address is P. O. Box 223, Bridgeport, Pa.

G-E Appoints New Electrode Distributor

The Machinery and Welder Corp., St. Louis, Mo., has been appointed as a distributor for G-E stainless-steel arc-welding electrodes, it was announced recently by General Electric's Welding Divisions.

This is an addition to the line of G-E a-c welding equipment and mild-steel electrodes that Machinery and Welder has carried for more than 20 years, it was said.

Stocks of the electrodes will be maintained in warehouses in Chicago, Milwaukee, St. Paul, Moline, and St. Louis. In addition to marketing the equipment, the company's offices in these cities offer application assistance to users.

the internal design and capacity of the spray nozzles used in a spraying operation often determine the cost and quality of that operation. See for yourself why Spraying Systems spray nozzles are the SPECIFIED nozzles of industry today. Write for Catalog 22 . . . the facts are all there.

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Post yourself on the latest advances in instrumentation by attending. Bring your engineers and operating executives. No charge—admission by registration only.

Write for preliminary program to the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa.

• Keep Informed . . .

G-E to Lease Ludlow, Vt., Manufacturing Facilities

The General Electric Co. announced that it has taken an option to lease manufacturing space in Ludlow, Vt., as part of its currently expanded jet-engine production program.

Several plants in the Vermont area were reviewed by the Company as possible sites prior to the selection of the Ludlow site, according to G-E officials at Lynn, Mass.

A company spokesman said that the G-E Aircraft Gas Turbine Divisions is seeking these facilities for "parts manufacturing operations, including die-sinking."

National Motor Bearing Co. Expands

Ground has been broken for construction of an addition to the plant of National Seal Co. which will add 40,000 sq ft of manufacturing area to the Van Wert, Ohio, subsidiary of National Motor Bearing Co., Inc., according to a recent announcement. Also scheduled for the company's latest expansion are a rubber compounding building which will have an area of 4000 sq ft and a second floor to the present office building which will add 5000 sq ft.

The company will soon begin production of a new-type "face" seal needed in large volume for military equipment and also for tractors, farm machinery, washing machines, and many other types of machinery. The new building will also house manufacturing of NMB's patented Airtron air ducting, heretofore made exclusively by Arrowhead Rubber Co., another subsidiary at Downey and Long Beach, Calif.

Roots-Connersville Expands Facilities

Investment of a million and a half dollars in a construction program covering new erection floor, expansion of present test facilities, manufacturing space, and machine tools was announced by Roots-Connersville Blower Corp., Connersville, Ind., one of the Dresser Industries, Inc.

These new facilities will enable Roots-Connersville to test the largest centrifugal blowers and compressors ever designed, which it is now building.

Kennametal to Erect New Building

Kennametal Inc., Latrobe, Pa., announces that it has purchased a 20-acre plot of ground near Bedford and will erect a new factory building of steel and concrete block construction having a floor area of 20,000 sq ft. They will move their mining tool fabricating division to this new site from the main plant to provide room for expansion of facilities for producing "Kentanium," the new heat-resistant titanium carbide. One of the largest potential uses for this material is in elements of airplane gas turbines. The company has designed and built a turbine with vital parts made of Kentanium as a service to prospective users. Tests are now being run on this power unit, and demonstrations for the benefit of engine builders are anticipated.

Elmes Engineering Division Celebrates 100th Anniversary

This year marks the 100th Anniversary of the Elmes Engineering organization—now the Elmes Engineering Division of American Steel Foundries—whose new home is the ultramodern plant, located at 1150 Tennessee Ave., Cincinnati, Ohio.

For generations the Elmes organization has been known the world over as one of America's leading manufacturers of hydraulic presses and equipment. The business was founded in 1851 by Carleton D. Elmes. The original plant, a small building in Bath, Maine, was devoted to job-work machining, principally for the marine industry.

At present, a complete line of hydraulic presses and equipment, both standard and custom-built, is manufactured by Elmes—metal-working presses, plastic-molding presses, extrusion presses, pumps, accumulators, valves, and accessories. Because of the new increased facilities, much larger presses and other hydraulic equipment units are now being built in an even wider range of types and sizes than ever before. Also, outstanding production economies are being achieved—savings that are passed on to customers in the form of lowest possible prices.

Allis-Chalmers to Build New Terre Haute Plant

A $5,000,000 engineering and construction program has been planned by the Allis-Chalmers Mfg. Co. in Terre Haute, Ind., according to a recent announcement.

The project will include a 500 × 800-ft manufacturing building and a 50 × 300-ft, three-story office building.

In the new plant, to be located on property adjoining N. 13th St., north of Terre Haute, Allis-Chalmers will manufacture compressors for the J65 Sapphire turbojet aircraft engine under a subcontract from the Curtiss Wright Corp.

Continued on Page 62

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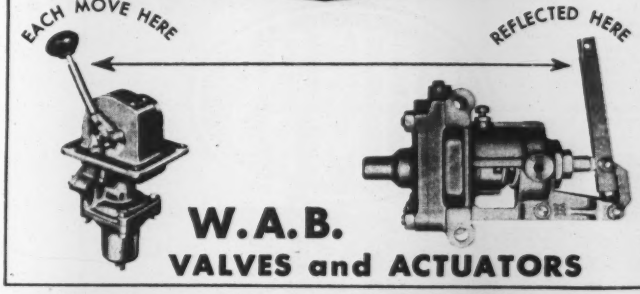

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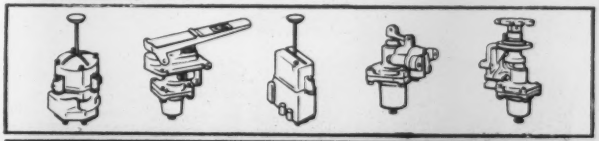
The smallest move of the control-valve handle is "echoed" by proportional movement of the actuator to throttle engines, graduate flow in process operations, positioning actuator to modulate fuel feed to boilers, etc. Eliminates complication and maintenance of mechanical linkage. Only connection is an air tube. Place controls at any distance from operation, centralize command of multiple operations. Hand, foot and cam operated valves available. Ask for Bulletin IDA 9481-1.



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• Keep Informed . . .

Westinghouse Builds Jet-Engine Parts Plant

A half-mile long manufacturing plant to be used for the production of jet-engine components and, after defense needs are met, for electric home appliances will be built near the Columbus, Ohio, city line, the Westinghouse Electric Corp., announced recently.

Purchase of the 350-acre Franklin County site on Route 40, three-quarters of a mile west of the city line, has been completed, survey crews have begun work, and construction will start immediately. The new building—the largest single plant yet to be built by Westinghouse—will have 1,900,000 sq ft of floor space.

Crane Begins New Plant Construction

Construction of new general offices and plant facilities of the Crane Packing Co., of Chicago, Ill., is underway. The new plant site, situated on Oakton Ave. near Lehigh in Morton Grove, Ill., will cover 133,000 sq ft when completed.

Wing Appoints Publicity Manager

L. J. Wing Mfg. Co., Linden, N. J., manufacturers of heating, ventilating, and combustion equipment, announce the appointment of Frank Story as advertising and sales promotion manager, with the title of publicity manager.

Construction Work Starts on Canada's Largest Cat

Construction work has started on Canada's largest fluid catalytic cracker, it was announced by the M. W. Kellogg Co., New York, N. Y.

The cracker—its capacity is rated at 25,000 bpd—is part of an over-all modernization program being undertaken by Imperial Oil Ltd., at its Sarnia (Ontario) refinery. Kellogg, through its subsidiary, Canadian Kellogg Co., Ltd., is also scheduled to build a 46,500-bpd two-stage vacuum and atmospheric distillation unit, as well as a light ends recovery system. The capacity of the distillation unit is also believed to be the largest in the Dominion.

When the equipment is on stream, the refinery's capacity will be increased by almost 30%, or to 71,000 bbl daily.

THE PEERLESS TYPE A PUMP

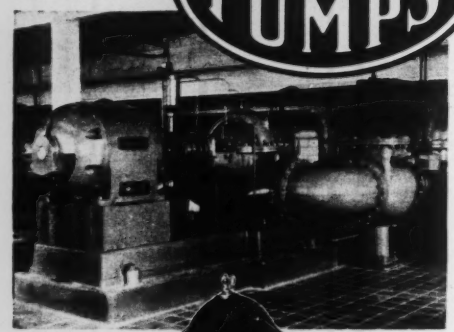
Continuous Duty
General Purpose

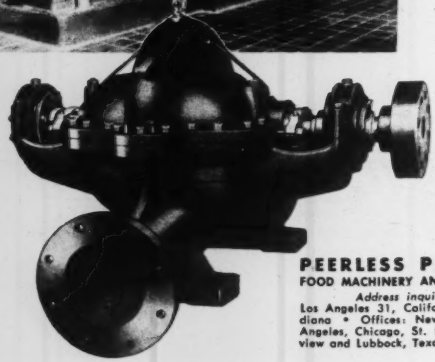
General Characteristics:

SINGLE STAGE HORIZONTAL SPLIT CASE DESIGN

DOUBLE & SINGLE SUCTION (Double Suction Sizes 1¼" through 48"; Single Suction Sizes 2" & 3")
BOTTOM SUCTION (Bottom Suction Sizes 12" through 42")
BALL BEARING
CAPACITIES: Up to 70,000 g.p.m.
HEADS: Up to 300 feet.
DRIVES: Direct-connected electric motor; belted drives; diesel, natural gas, and gasoline engine; steam turbine; combination drives.
TEMPERATURES: Handles liquids up to 300°F.

PEERLESS PUMPS





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TYPE **A** *for Advanced design*

TYPE **A** *for All capacities and heads*

TYPE **A** *for Ample safety factor*

TYPE **A** *for Accuracy in construction*

TYPE **A** *for Added service life*

Write for Bulletins describing this and other Peerless horizontal and vertical pumps for application to all municipal services, from water supply through waste disposal.

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• LATEST CATALOGS

Fractional Horsepower Gearing

Small gears are made in almost endless variety. Frequently their applications are entirely without precedent. New principles, new design, new engineering—a different approach to power transmission problems—all these things and more are often required to produce greater efficiency and economy in small gears. In a new 6-page 2-color $8\frac{1}{2} \times 11$-in. folder, recently issued by Gear Specialities, Inc., Chicago, Ill., 15 interesting halftone illustrations present a few of the many different types of fractional horsepower gearing made by G. S. Also featured is a picture-trip through the modern, daylight G. S. plant. On the back page are two useful standards charts.

Reciprocating Pump

The Aldrich Pump Co., Allentown Pa., offers Data Sheet 64 A—describing the recently developed Aldrich 3-in-stroke direct-flow triplex pump. This 2-color, 6-page bulletin illustrates and presents features of design, construction, dimension drawings, and performance data. Applications for Aldrich direct-flow pumps include: chemical handling, hydraulic systems, and oil field service.

High-Temperature Insulation

A new four-page folder on Superex block insulation issued by Johns-Manville, New York, N. Y., tells the economic advantages of Superex and lists the outstanding properties of this insulation. This information is backed up with conductivity and heat loss graphs, as well as a recommended thickness table.

The back cover shows a few of the many special shapes in which Superex can be furnished.

New Teletron Catalog

A new Du Mont Teletron Catalog is now being offered to the trade by the Cathode-ray Tube Division of Allen B. Du Mont Laboratories, Inc., Clifton, N. J. This latest picture tube literature lists the latest types, including the 30-in. Teletron, type 30BP4. Comprehensive technical information is given for the various Teletron Types with complete data on the two new electrostatic-focus types 17FP4 and 20GP4.

This 12-page publication also provides complete ion-trap-adjustment directions for all Du Mont Teletrons, and basing details for both electrostatic-focus and magnetic-focus types.

• Keep Informed

Four Keys to Increased Production

There are four keys to increased production and lowered operating expense—and all four of them are ably illustrated in the 1951 issue, of "Studies in Centralized Lubrication," published by the Farval Corp., Cleveland, Ohio.

Briefly, these keys can be described as follows:

1 Production time saving. No downtime for lubrication or costly bearing replacements.

2 Manpower saving. Lubrication labor is eliminated.

3 Lubricant saving. No more wasted lubricant—savings average 75%.

4 Bearing saving. Proper lubrication increases bearing life as much as 25 times.

Totally Enclosed Fan-Cooled Motors

A new bulletin No. 05B7150A released by Allis-Chalmers, Milwaukee, Wis., describes types of construction and ratings of its improved totally enclosed, fan-cooled motors with tube-type air-to-air heat exchangers.

Included in the bulletin is a chart showing ratings of Allis-Chalmers totally enclosed, fan-cooled motors available in squirrel-cage, wound-rotor, and synchronous types for both horizontal and vertical installation, and a cross-section view of horizontal motor construction features. Among these are capsule-type bearings, protected air intakes, and pipe-plug protected tapped holes for checking air gap with feeler gages.

Spray Nozzles

A 20-page bulletin No. N-617, published by Yarnall-Waring Co., Philadelphia, Pa., on spray nozzles replaces the 16-page 1949 edition N-616.

Details covering Yarway involute nozzles for spray cooling ponds are given. Corresponding information on smaller involute and flat-spray nozzles for industrial processes are also included.

Industrial Lighting

Increased demand for better industrial lighting is reflected by a new 16-page lighting-at-work booklet No. B-4727 available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Aimed at the industrial plant operator, this booklet stresses three ways that better lighting can work for him: (1) it can cut cost by making possible increased production; (2) increase efficiency by insuring accuracy; (3) reduce accidents by clearly exposing dangerous operations.

Special lighting for special areas is illustrated, such as dust and vaportight units for service in corrosive atmospheres, and bin and stack luminaries that direct light into bins and stock rooms.

Boiler Feed Pumps

A new high-pressure barrel-type boiler feed-pump bulletin No. 1525 has been issued by and is available from De Laval Steam Turbine Co., Trenton, N. J.

The bulletin contains a complete description and cross-section drawing of the pump. Some of the main features of the pump include the following: Available for pressures to 3000 psi, ability to be thrown on the line quickly, without slow preliminary warming up, automatic balance eliminates axial thrust and is unaffected by temperature or wear, double volutes eliminate radial load—permit rising head capacity curve, diaphragms are individually bolted to prevent distortion due to temperature changes, axially split radial bearings are pressure lubricated.

Continued on Page 64

What they say!

"We use your Helicoid Gages in very severe pulsation work and have found them very satisfactory."

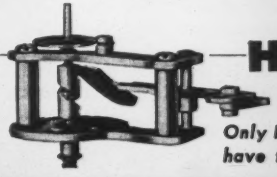
"A Helicoid Gage operating under the worst conditions for 4,000 hours is still functioning, although other gages have been worn out."

"... no other gage has come close to giving such long life and accuracy as the Helicoid."

"Your Helicoid Gages have been used in our plant for more than five years and have proved their superiority over competitive makes."

"We have six gas engines equipped with Helicoid Gages on the oiling system, subject to more vibration than any rack and pinion gage will stand."

All quotes are taken from letters in our files. Write today for HELICOID GAGE catalog.



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Only Helicoid Pressure Gages have the Helicoid Movement

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▼ **FORM TOOL LIFE INCREASED 36% WITH STUART'S SPEEDKUT B**—on 6 spindle automatics forming and threading cut-off cap screws of SAE 1060, 10-17 Rockwell C.

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ARE YOU really getting the capacity that was built into your automatic screw machines? In shop after shop, Stuart oils correctly applied have upped production substantially and, as a by-product, have usually improved quality and increased tool life.

It is worth finding out what a Stuart Representative can accomplish for you. Ask to have him call and SEND FOR EDUCATIONAL LITERATURE on cutting fluids for screw machines.

STUART *service goes with every barrel*

D. A. Stuart Oil Co.

2741 S. Troy St., Chicago 23, Ill.

• Keep Informed

Conveyer Chains

A new bulletin, No. 51-60, on Rex Table Top Chain which might almost be classed as a handbook on flat-top conveyer chain, has been issued by Chain Belt Co., Milwaukee, Wis. Besides showing and describing details of construction, new, unusual, yet practical applications of Table Top are shown. Considerable engineering data is given, as well as a table of strength, weights, dimensions, and prices. All the data needed to select Table Top sprockets is furnished.

An extra feature of this new book is the section devoted to Rex FlexTop Conveyer Chain. Baldwin-Rex Plate Top Conveyer Chain, and Rex Double Flex Chain.

Rex FlexTop is the newest conveyer chain manufactured by Chain Belt Co. Applications are described and illustrated, and engineering and pricing data presented both on the chain and the sprockets to be used with it.

Textile Finishing Equipment

Electrical equipment for textile finishing is described in a new 32-page booklet No. B-4034 available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

From the electrical standpoint, some of the most challenging jobs in the Textile Industry are the drives that power the large continuous finishing ranges. This new booklet contains information on many drives of this type that have been installed and are operating in various plants throughout the industry.

The booklet describes basic factors in selecting drives for continuous ranges. It tells how the Westinghouse adjustable-voltage drive controls tension—even more important in dyeing ranges than in bleaching ranges, since tension affects not only the strength of the finished cloth but the color as well. In addition to continuous finishing ranges, the booklet describes the latest type drives for semicontinuous batch processes, as well as other miscellaneous equipment for textile finishing applications. Another section discusses drives for printing ranges, where the basic requirement is good tension control—accurate so that good print register is maintained, and adjustable to enable the machine to handle different types of cloth.

Aircraft Equipment

Bulletin No. GEA-4866A, "G-E Transformers for Aircraft," is now available from General Electric Co., Schenectady 5, N. Y. The 28-page publication deals with ballasts for fluorescent lighting for aircraft, general purpose transformers, "flyweight" silicone transformers, phase-changing transformers, ignition transformers, and jet ignition transformers.

Bulletin No. GEA-5628, which deals with the General Electric 28-volt generator control systems for multi-engined aircraft, is also available. This booklet deals with a centralized system and shows how protection is provided against overvoltage, ground fault, reverse current, and undervoltage.

SR-4 Torquemeter

Baldwin-Lima-Hamilton Corp., Philadelphia Pa., announces Bulletin No. 328, 8 pages, describing and illustrating Baldwin SR-4 torquemeters, which are based on measurement with special SR-4 resistance wire strain gages. The bulletin brings specifications up to date for an increasing number of standard instruments for any speed and many types of service. New dimensional tables, and tables for instrument characteristics and standard graduations for instruments ranging from 100 to 30,000 in. lb are included.

ENGINEERS

If You're Interested in Yourself—We're Interested in YOU!

You may think this an unusual attitude for an employer to take, but the fact is, "self-interest" is often overlooked and even considered undesirable by some employers.

But here at Honeywell, we believe self-interest is healthy for our employees and for this company. And we back up our belief not only with money, security and the usual "fringe benefits," but also by giving people satisfying, challenging work and opportunity for advancement NOW—not tomorrow or next year.

Consider the self-interested engineer. He wants always to use the latest in electronic and engineering techniques. He wants to work at his full creative capacity. He wants to show more than just a fraction of his actual potential. Because he knows that in this kind of position lies his best opportunity to further his career.

So—here at Honeywell—we take great care to put a self-interested engineer in his proper field—research, development or design. We let him loose in basic research. Or we give him meaty problems in electronics and electro-mechanical devices. We let him tear into gyro, servo-mechanism, relay, heat transfer, electrical contact phenomena or aeroelasticity. In other words—we give him the work he wants and needs to do.

Yes, Honeywell goes for self-interested engineers. We want them when we find them and we keep them when we get them.

If this kind of thinking appeals to you, the chances are you'll be mighty valuable to yourself and to us by working at Honeywell. Why not start *right now* to do something about it? Depending on the location you prefer, write to H. D. Elverum, Personnel Department ME-2, Minneapolis 8, Minn. or W. Reiterman, Personnel Dept. ME-2, Philadelphia 44, Pa., giving your qualifications and experience. Your letter will be held in the strictest confidence, of course.

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ESL BIBLIOGRAPHIES

No. 1. Filing Systems for Engineering Offices. 41 references. 1948. $2.00.

No. 2. Prestressed Reinforced Concrete. 190 references. 1948. $4.00.

No. 3. Precision Investment Casting by the Lost Wax Process. 111 references. 1949. $2.50.

No. 4. Pallets Used in Modern Materials Handling. 114 references. 1949. $2.00.

No. 5. Machinery Foundations; Design, Construction, Vibration Elimination. 120 references. 1950. $2.00.

No. 6. Non-Metallic Bearings. 101 references. 1950. $2.00.

No. 7. Domestic and Industrial Applications of Solar Heating. 149 references. 1950. $2.00.

No. 8. Management of Construction Jobs. 53 references. 1950. $2.00

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• Keep Informed

Carbon Brushes

A new two-color, 28-page booklet entitled "Carbon Brushes for Electric Equipment" has been announced as available from the General Electric Co., Schenectady 5, N. Y.

The bulletin, No. GEA-5597, describes and illustrates the fundamental considerations given to the design, application, and manufacture of carbon brushes and includes a section on brush terminology.

Included are sections on types of brushes, characteristics of brush grades, brush grade recommendations, mechanical design of brushes, and tips on brush replacement.

Drill Press Manual

"How to Run A Drill Press" is the title of a new manual for shop men, recently announced by South Bend Lathe Works, South Bend, Ind. This book has been prepared as a companion to the Company's best seller "How to Run A Lathe."

Devoted exclusively to the small sensitive-type drill press, this book contains a wealth of practical information of value to the experienced machinist as well as the beginner. The section covering care, operation, and maintenance includes illustrations giving the name and function of all important parts and correct adjustment of each unit. Detailed instructions and clear illustrations take all the mystery out of grinding the drill point so it will cut properly.

Best methods for mounting and removing chucks and tools are explained and many paragraphs are devoted to best practices for laying out and setting up work.

"How to Run A Drill Press" contains 32 pp., size $5^1/_8 \times 8$ in., and more than 75 illustrations. It can be secured direct from the South Bend Lathe Works, South Bend 22, Ind. Price is 25¢ postpaid.

Blue Brute Hose Fittings and Line Oilers

A bulletin and a specification sheet—the first in a series to supersede the Blue Brute Accessories Catalog—have been announced by Worthington Pump and Machinery Corp., Harrison, N. J.

The first, Bulletin H-1200-B44, on Blue Brute Hose Fittings, includes sizes, parts numbers, and applications. The fittings include hose nipple, union nut, hose clamp, coupling spud, reducing coupling spud, spud, reducing spud, threaded pipe nipple, hose valve, and splicing nipple.

The second, Specification Sheet H-1200-B45, pictures and describes the Blue Brute 2 qt Line Oiler, giving detailed specifications.

Oil-Burner Equipment

The Hauck Electric Oil Heaters, described in Catalog No. 709, issued by Hauck Mfg. Co., Brooklyn, N. Y., are ideal for efficiently heating heavy grades of fuel oil with automatic control of oil temperatures. They frequently eliminate the need of long steam and condensate line extensions or new steam-generating installations where steam is not available for heating oil.

With the suction-type heater, the heavy oil is easily heated and maintained at the proper pumping temperature. The preheater then heats the oil from pumping temperature to the higher temperature usually required at the burner for good atomization and combustion of oil.

Also available is Hauck's new Catalog No. 704-A about the Hauck micro cam oil valves for controlling the flow of oil to Industrial Oil Burners.

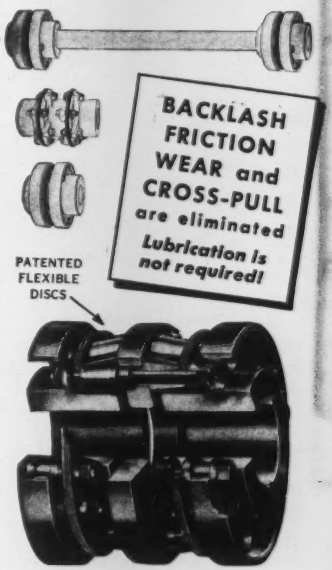
Continued on Page 66

THOMAS
Flexible ALL METAL COUPLINGS
FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years



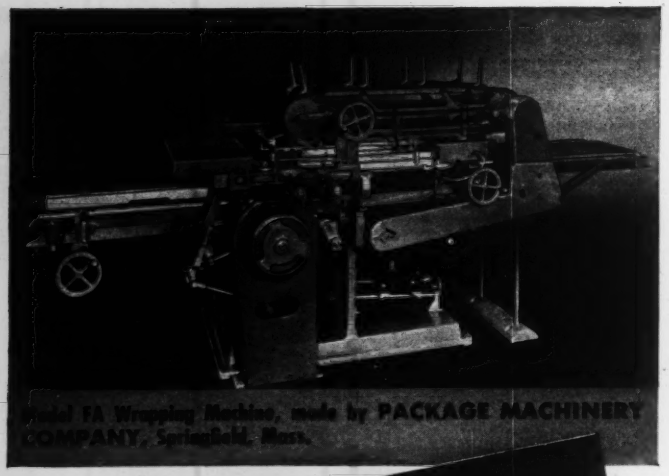
THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA



-they say:

"We recommend This Lubricant to Our Customers"

"We have found LUBRIPLATE Lubricants to be very effective and use them extensively in our machines."

"To assure the proper use of LUBRIPLATE Lubricants for re-lubrication, we place tags on our machines before shipment. Thus the purchasers of those machines know the LUBRIPLATE Product we recommend for each application and where to obtain it."

The Package Machinery Company of Springfield, Massachusetts is among the earliest users of LUBRIPLATE Lubricants. They use them for original lubrications because LUBRIPLATE Lubricants arrest progressive wear and add longer life to moving parts. They recommend them for re-lubrication to preserve the efficiency of the machines, to reduce power costs and minimize service work and parts replacement.

LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases. There is a LUBRIPLATE Product best for your every lubrication need. Write for case histories of the use of LUBRIPLATE in *YOUR* industry.

LUBRIPLATE DIVISION
Fiske Brothers Refining Company
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DEALERS EVERYWHERE . . . CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE *THE MODERN LUBRICANT*

• Keep Informed

Felt—An Engineering Material

Wool felt is one of the oldest of modern engineering materials. Associated by centuries of use with clothing, footwear, and miscellaneous applications of comfort and protection, its adaptable range of densities from soft to hard, and the fact that it is resilient, durable, and will not ravel when cut are the innate characteristics responsible for its traditional position among natural materials.

In step with technological advancements within the past generation, wool felt has been employed extensively as an intermediate or nonstructural engineering material and has earned a place of growing importance among yieldable substances in mechanical engineering. Under the pressure of war production, the mechanical uses of felt have been further expanded, and certain of its properties have been improved by the supplementary treatment of finished felts. Developments of this type, coupled with engineering and research in modern felt laboratories, are opening broader fields of usefulness for mechanical felt products and invite attention to the origin, construction, and physical properties of this basic material.

"Felt—A Mechanical and Engineering Material," published recently by the American Felt Co., Glenville, Conn., describing the manufacture, properties, uses, specifications etc., is now available at $1.50 per copy.

Strain Gages

Description and specifications for a new SR-4 "Post-Yield" resistance wire strain gage, suitable for strains up to 10 per cent, are given in Bulletin 322 of Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Bulletin No. 325 on the new Type P SR-4 tension load cells is also announced by Baldwin. These cells are based on SR-4 bonded resistance wire strain gages for load measurement. The 2-page bulletin illustrates and gives specifications for load cells of four capacities between 10,000 and 100,000 lb.

Silicone "O" Rings

The Arrowhead Rubber Co., Downey, Calif., is offering design engineers two new manuals which give complete information on "O" rings molded from silicone rubber compounds. Because of the inert nature of silicone rubber, these rings have excellent resistance to many oils, acids, alkalis, and a variety of chemicals, and demonstrate astonishing resistance to oxidation and aging, even at abnormally high temperatures. Flexibility at—130 F and resistance to temperatures of 500 F and over are features of these seals, which also possess excellent dialectric properties. Actual savings are possible through the use of silicone "O" rings which give satisfactory service under conditions which would cause rapid deterioration of ordinary seals. Under normal conditions, they last indefinitely. Silicone "O" rings are especially suitable for use as a static seal where replacement presents a problem, or where long service life is essential.

One of the manuals, offered by Arrowhead, gives the latest comprehensive data on silicone rubber—its uses and characteristics, with typical applications; the other manual gives all necessary information on the use and selection of "O" ring seals. Includes such valuable data as proper design of mechanisms and equipment using "O" rings, the importance of designing for proper "O" ring installation, illustrations of good designs for simplifying installation, and precautions to be taken to avoid damage to seals.

• Keep Informed . . .

Gas-Engine-Driven Compressor

A bulletin covering the new Clark HLA 17 × 19-in. Gas-Engine-Driven Compressor, has been issued by Clark Bros. Co., Inc., Olean, N. Y.

The 10-cyl model rated at 2500 bhp not only is as large as any gas-engine-driven compressor currently being manufactured, but is said to deliver more horsepower per square foot of floor space than any other gas-engine-driven compressor in the world. The HLA is a natural development stemming from the Clark HBA design and incorporates all of the time-proved design features of the HBA, plus substantially increased horsepower.

Pipeless Metalworking Presses

American Steel Foundries, Elmes Engineering Div., Cincinnati, Ohio, has issued a 6-page Bulletin No. 1011 which illustrates and describes the new Elmes pipeless metalworking presses. Main hydraulic circuit has no piping. All high-pressure fluid is conducted through short, direct passages drilled in structural parts. Result is remarkably low-cost maintenance with downtime practically eliminated.

Dust Control

A revised treatise, Bulletin No. 98, on industrial dust collection has been published recently by The W. W. Sly Mfg. Co., of Cleveland, Ohio. This 20-page illustrated booklet discusses the principles of dust control by filtration, determination of air volume, hood design, piping, and other features, and contains numerous diagrams, tables, and other valuable information.

Pneumatic Rivet Passer

Hot rivets delivered pneumatically at high speeds to riveters more than 150 ft away is the outstanding operating feature of the improved Penflex pneumatic rivet passer.

Substantial savings in time and labor can now be realized by plate and structural fabricators, shipyards, ship repair companies, and other plants concerned with defense production.

Copies of the Penflex Pneumatic Rivet Passer folder can be obtained by writing the Pennsylvania Flexible Metallic Tubing Co., Dept. RP1, 7200 Powers Lane, Philadelphia 42, Pa.

Hook-On Power-Factor Meter

A new hook-on power-factor meter, which permits direct measurement of power factor without cutting conductors or interrupting electrical service, has been announced by the General Electric Co., Schenectady, N. Y., and is described in Bulletin No. GEA-5469. The type AK-3 power-factor meter may be used on any balanced 3-phase circuit. It gives direct power-factor readings in circuits with voltages ranging from 100 to 600 volts and currents from 15 to 600 amp.

To operate the instrument, the user merely clips the voltage leads to the potential source, clamps the hook around the conductor, and rotates the selector dial to obtain the proper power-factor reading. No complex connections or control settings are required. The meter gives readings accurate to within 0.05 power factor. It has a frequency range of 50 to 90 cycles, an effective scale length of 13.5 in.

Power-Factor Visualizer

A power-factor visualizer that presents a simple explanation of the use of capacitors in solving low power-factor problems is available from the Westinghouse Electric Corp. Prepared in the form of a slide-rule-type chart, the visualizer makes it possible to follow a hypothetical case involving low power factor and shows how the installation of capacitors can solve this, as well as many similar problems.

The chart explains just what low power factor is, what it means to both the power user and the power supplier, and what benefits can be obtained by improving the power factor in the industrial distribution system through the installation of capacitors.

For a copy of the Power-Factor Visualizer (SA-6739) write the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Safety

That sound caution and strict observance of sensible safety rules pay off for the fork-truck driver as well as for his employer, is the theme of a new booklet issued by Clark Equipment Company's Industrial Truck Division, Battle Greek, Mich.

With the title "Safety Saves!", the book sets forth the "do's" and "don'ts" which experience has established as a simple, practical code of industrial truck operation. The various admonitions, presented in an easy-to-take, good-humored fashion, and pointed up by cartoons, are offered as an excellent "refresher course" for experienced operators, and as a helpful statement of fundamentals for those new at the job.

SAFE • STRONG • SECURE

Before specifying or purchasing open steel flooring check these exclusive features of Blaw-Knox Grating...

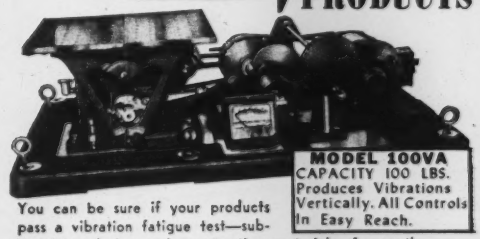
1. SAFETY underfoot at all times assured by twisted steel cross bars.
2. STRENGTH that only rigid "one-piece" Electroforged construction can provide.
3. SECURITY—no wobble, tilt or rattle caused by loose or lost screws, nuts, bolts.
4. EASY to maintain and paint . . . no sharp corners to clog with dirt.
5. MAXIMUM open area for light and air.

For complete data on Blaw-Knox Electroforged Steel Grating and Stair Treads write for Bulletin 2365.

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY
2105 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX *Electroforged*
STEEL GRATING & STAIR TREADS

VIBRATION Fatigue Tests
POINT THE WAY TO IMPROVED PRODUCTS



MODEL 100VA
CAPACITY 100 LBS.
Produces Vibrations Vertically. All Controls In Easy Reach.

You can be sure if your products pass a vibration fatigue test—substantiates design and construction materials—frequently exposes excessive material. Many things can be learned from tests. A "must" for electronic, aircraft and automotive parts and assemblies. Hundreds in use. Models to handle parts from 10 lbs. to 100 lbs.—choice of vertical or horizontal table movement. Frequencies of 600 to 3,600 v.p.m. Special machines to order. Catalog F contains treatise.

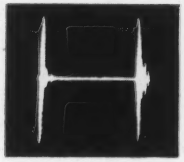
Made by makers of ALL AMERICAN PRECISION DIE FILING MACHINES

ALL AMERICAN
Tool & Manufacturing Co.

1016 Fullerton Ave., Chicago 14, Ill.

LEADERSHIP can't stand still

this time it advances on ultrasonic waves

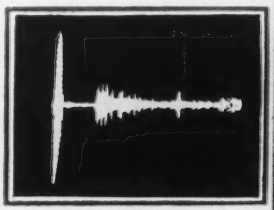


Because production isn't always perfect, inspection of all materials is essential to assure quality. When new inspection tools and methods have demonstrated their usefulness, they replace or supplement the old.

Nondestructive inspection *inside* the metal is now made possible through the Ultrasonic Reflectoscope. The American Brass Company has adapted its use to inspect large plates of copper alloys, thus making doubly sure that *hidden* defects are not present—defects which may appear in machining or forming operations and cause costly rejections.

In keeping with a tremendous mill-improvement program, the introduction of the Ultrasonic Reflectoscope in this industry is another indication of Anaconda's leadership in quality control in the field of copper and copper alloys. The American Brass Company, General Offices, Waterbury 20, Connecticut.

S1103



This is what happens:

Simple to operate, the portable Ultrasonic Reflectoscope sends intermittent high-frequency sound waves angularly into the plate. If unimpeded, the waves will reflect from the opposite edge of the plate and indicate a normal pattern on the screen of an oscilloscope, as illustrated opposite the headline.

Any hidden flaw or internal defect will result in a discontinuity of the wave and will be instantly evident on the screen, as pictured immediately above.

R ALLOYS

PRECISION COMES IN ANY SIZE FARREL® GEAR

from 1/4 inch to 20 feet in diameter

Farrel herringbone gears are made in a complete range of sizes from 1/4 inch to 20 feet diameter, 1/4 to 60 inch face, 24 DP to 0.75 DP, for any power capacity and any application. The quiet, vibration-free performance and long life you can expect from these gears result from extreme accuracy of tooth spacing, contour and helix angle . . . qualities inherent in the Farrel-Sykes method of gear generation.

Straight tooth (spur) gears and single helical gears are supplied in any size from 1/4 inch to 20 feet diameter, 1/4 to 30 inch face, 24 DP to 0.5 DP. Also available are large internal gears, with either spur or helical teeth, in sizes up to 16 feet diameter, 12 inch face, 1 1/4 DP.

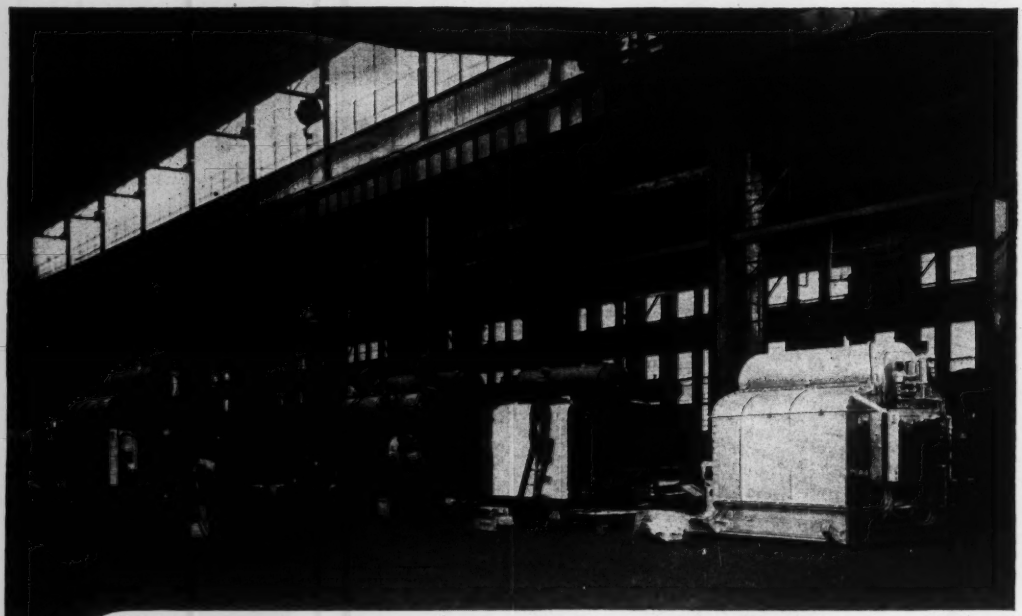
Farrel engineers will be glad to assist you in working out unusual gear problems. Information about Farrel precision herringbone gears, or any of the other types mentioned on this page, will be sent on request.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y. Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans

Farrel-Birmingham ®

FB-673

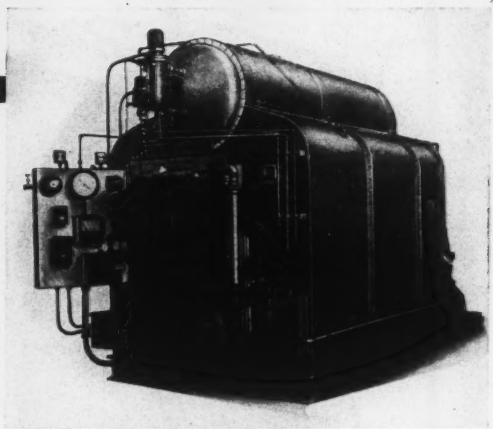


KEYSTONE STEAM GENERATORS

. . . are ON THE MOVE

. . . the steady flow of "Keystones" thru our shops at Erie indicates the wide acceptance of a new idea in steam generation—they are compact 2-drum water tube boilers with integral furnace and automatic firing.

This unique "packaged" boiler design provides quick installation of new steam capacity in the field by simply making the usual service connections. Complete description and dimensions are contained in Bulletin SB-38—yours for the asking.



Typical of the 13 standardized sizes is the above 150 h.p. Erie City Keystone Steam Generator. These are available from 75 to 800 h.p. for pressures from 160 psi.

COMPLETE STEAM POWER PLANT EQUIPMENT

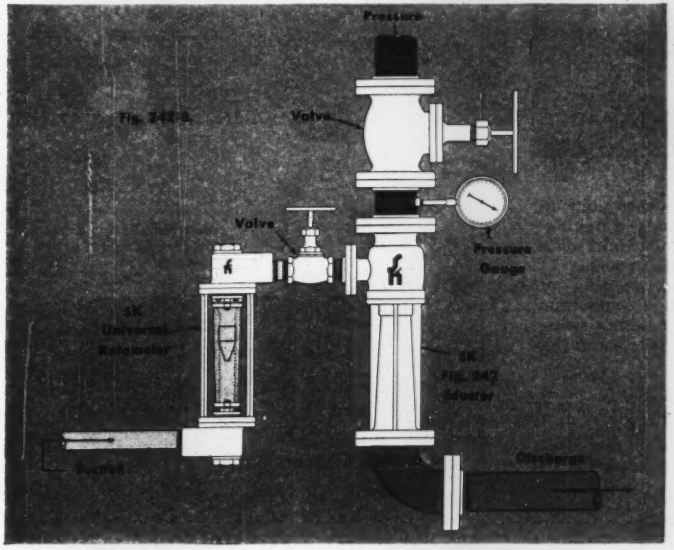
ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

News

Here's An Easy Way To Measure And Mix Liquids Into Continuous Streams



The system above is simplicity itself. It consists of an SK Rotameter and an SK Jet Eductor. It represents only one of numerous possible variations. With this system, you can mix two liquids in desired proportion in one continuous operation.

Flow of the pressure liquid is controlled by a valve and the orifice of the eductor nozzle. The pressure liquid passes through the eductor nozzle with sufficient velocity to draw in and entrain the suction liquid. Rate of flow of the suction liquid is measured by the Rotameter and controlled by a valve in the suction line. Both liquids are intimately mixed—within the eductor to a degree not obtainable with most other types of mixing apparatus—and are discharged through the discharge line. The mixing ratio remains constant as long as the pressures are held constant.

Of importance is the fact that the eductor has no moving parts—the Rotameter but one, the rotor. Maintenance, therefore, is low. Operation is consistently efficient. In addition, the eductor can be made of special materials to handle corrosive liquids.

The system is flexible. Additional liquids can be mixed by extending the system. SK Controlling Rotameters can be used in pressure and suction lines to proportion flows under changing conditions.

The SK Rotameter illustrated is a stock item, immediately available. Jet Eductors are built to meet job requirements. For details on the many types of Jet Eductors, request Bulletin 2-M. For information on all types of Rotameters, request Bulletin 18-RA. We'll send you either or both, promptly.

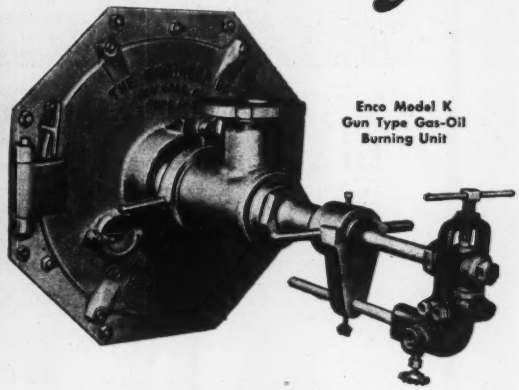
At International Harvester Company's West Pullman Works, SK Rotameters, mounted on panels as shown in the photo, are used for test checking carburetors of various engines made by the company. The carburetors are installed in snap-jigs and are tested at low and wide-open flow—which corresponds to idling and full-speed operation. The Rotameters are used to check the air and fuel consumption. Since this is a production operation involving the checking of thousands of carburetors, instruments which would indicate almost instantly were necessary. The SK Rotameters, after installation, met all specifications for both speed and accuracy. *For information on SK Universal Rotameters for panel mounting, request Bulletin 18-RB.*

SK Flow Indicators, designed to permit visual inspection of flow in a pipe line, can prevent damage to expensive equipment by indicating to observer whether or not a fluid is flowing. For information on the many types and sizes of SK Flow Indicators available, request Bulletin 18-W.

Manufacturing Engineers

flexible... 3 ways

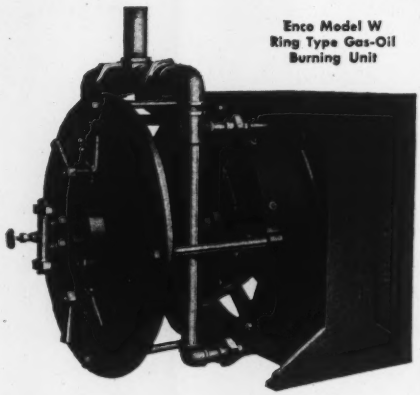
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



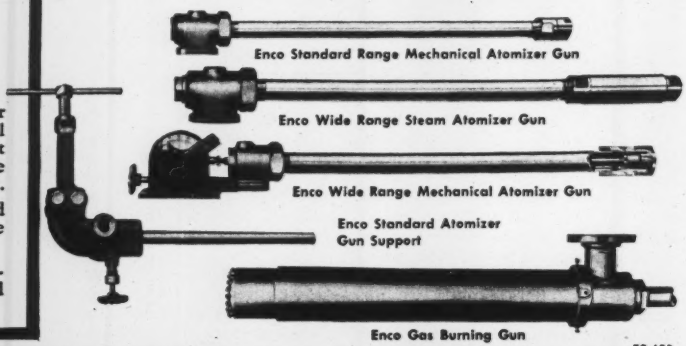
Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

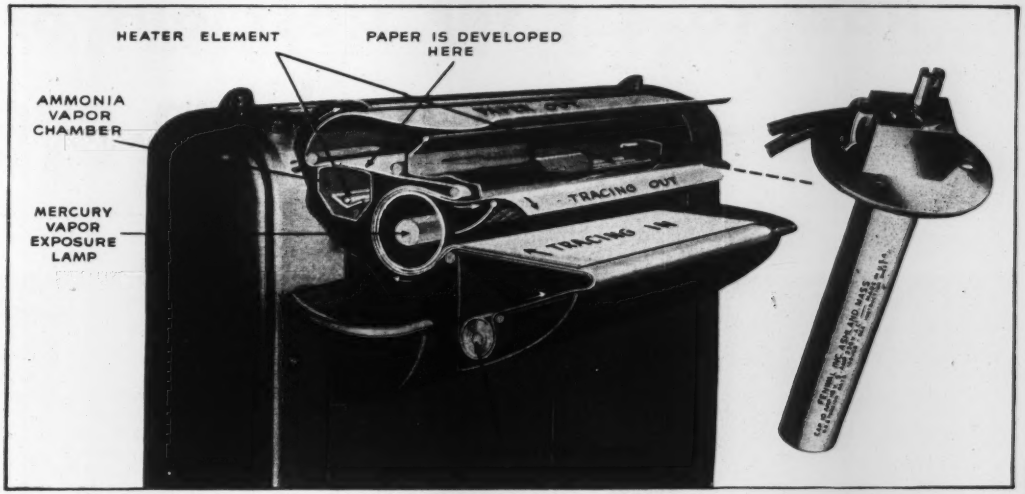
Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.


Enco Standard Range Mechanical Atomizer Gun
Enco Wide Range Steam Atomizer Gun
Enco Wide Range Mechanical Atomizer Gun
Enco Standard Atomizer Gun Support
Enco Gas Burning Gun

EC-483

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: P. J. BARKER, LTD., 4230 NORVILLE ST., MONTREAL 34 P.Q.



Heat control problem in Ozalid reproduction machine solved

by Multi-Purpose Thermostat

When the Ozalid Streamliner reproduction machine was designed, a vital factor toward its successful performance was the maintenance of an even temperature within the developer tank.

After sensitive paper has been exposed, it is conveyed across the perforated top of the developer tank and developed by controlled aqua ammonia vapors. These vapors are superheated by a heater within the tank. Even heating at a specified temperature is imperative as, otherwise, uneven development results.

A low-cost THERMOSWITCH thermostat solves this heat control problem. It effectively maintains the vapor at a steady temperature for optimum developing conditions, by reacting both to vapor temperature and to radiant heat from the heater.

This application is but one of many types of control problems in which easy-to-install, easy-to-maintain Fenwal THERMOSWITCH thermostats have proved successful. Their activating control element is the single-metal shell that expands or contracts *instantaneously* with temperature changes, making or breaking the totally enclosed electrical contacts. Through this unique principle, THERMOSWITCH Units effectively control *many* variables where heat is a factor.

Find out now how Fenwal THERMOSWITCH Units can help you in *your* product. Mail coupon today.

Visit our Booth 206 at the National Instrument Exhibit, Houston, Texas

Fenwal

THERMOSWITCH

The Precision Multi-Purpose Thermostat Control

SENSITIVE . . . but only to heat

FREE! **Get this bulletin . . . see what Fenwal THERMOSWITCH units can do for you.**
Just fill in coupon and mail . . . no obligation.

FENWAL, INCORPORATED, 58 Pleasant St., Ashland, Mass.
111 South Burlington Ave., Los Angeles 4, Cal.
TEMPERATURE CONTROL ENGINEERS

Name ..... Position .....
Company .....
Street .....
City ..... Zone ..... State .....

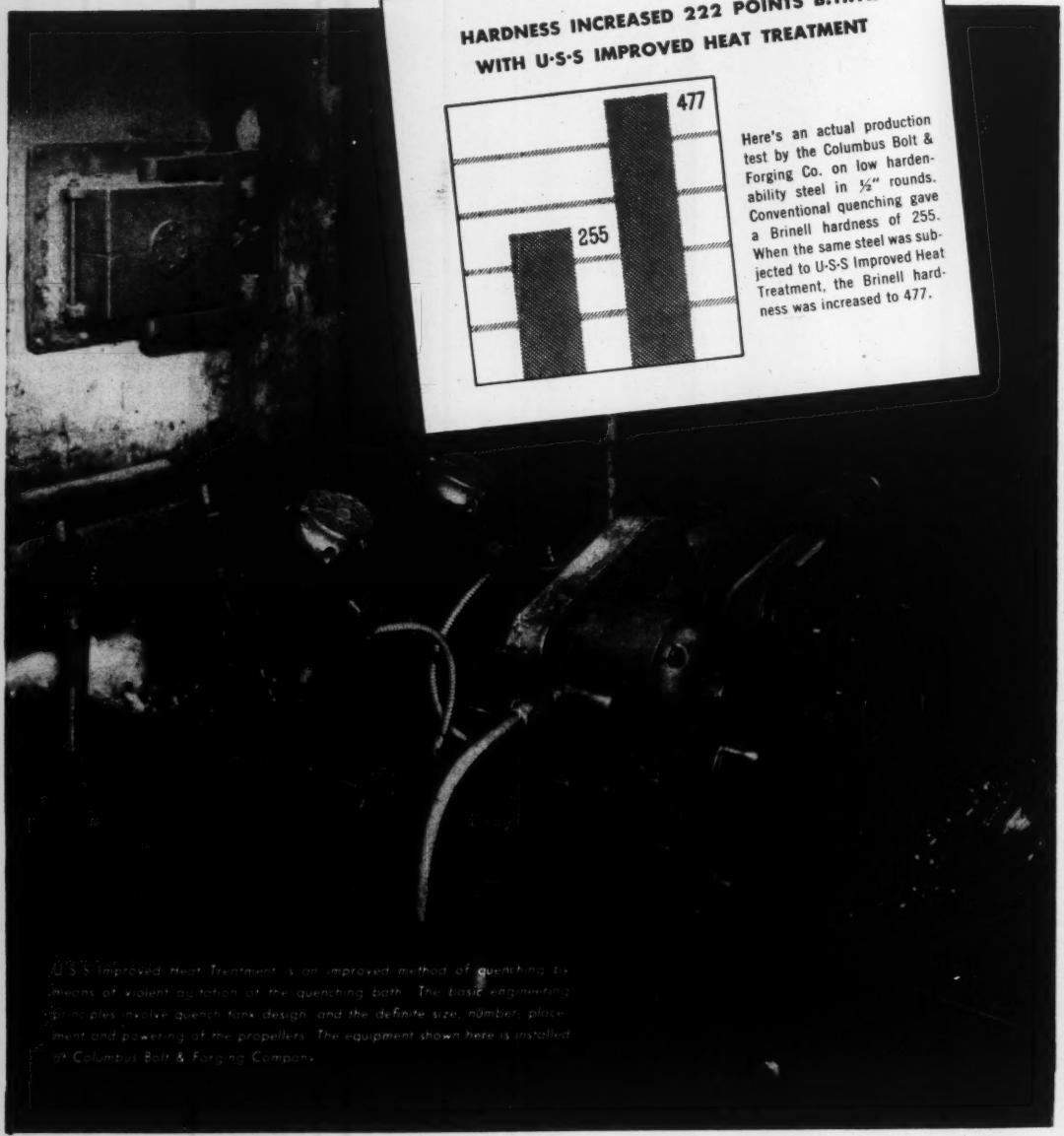
I am chiefly interested in the applications checked:

- ☐ Heating
- ☐ Cooling
- ☐ Humidity Control or Detection
- ☐ Alarm (over-temperature, under-temperature)
- ☐ Vapor Level Control
- ☐ Timing (thermal)
- ☐ Radiant Heat Control
- ☐ Pressure Control (by controlling vapor temperature)

OTHER (Please fill in your special requirements) .....
.....
.....

HOW TO GET THE MOST OUT OF

—keep a sharp eye


HARDNESS INCREASED 222 POINTS B.H.N.
WITH U·S·S IMPROVED HEAT TREATMENT
477
255
Here's an actual production test by the Columbus Bolt & Forging Co. on low hardenability steel in ½" rounds. Conventional quenching gave a Brinell hardness of 255. When the same steel was subjected to U-S-S Improved Heat Treatment, the Brinell hardness was increased to 477.
U·S·S Improved Heat Treatment is an improved method of quenching by means of violent agitation of the quenching bath. The basic engineering principles involve quench tank design and the definite size, number, placement and powering of the propellers. The equipment shown here is installed at Columbus Bolt & Forging Company.

THE ALLOY STEEL YOU'RE GETTING

on quenching methods

TODAY, as critical alloying elements become scarce, all users of alloy steel are faced with the necessity of getting the most out of the steel they're receiving.

In most cases, this puts the problem squarely up to the heat-treater. Better heat-treatment methods can often do the job.

If you encounter difficulties, don't be too quick to blame the steel or the heating practice. The answer may be better *quenching* methods. More specifically, your problem might be solved with U·S·S Improved Heat Treatment — a superior quenching technique developed by United States Steel.

U·S·S Improved Heat Treatment extracts heat rapidly and *evenly* from every part of the material's surface. This treatment assures accurate timing, allowing removal of the material from the quenching bath while a certain amount of residual heat is present. Elapsed time from quench to tempering treatment is held to an absolute minimum. This not only improves mechanical properties; it also reduces cracking. And, this quenching method improves machinability by minimizing the formation of free ferrite in hypo-eutectoid steels.

The use of this quenching process is available to you without charge.

United States Steel does not manufacture or sell heat-treating equipment, but our metallurgists will be glad to analyze your heat-treating methods and make suggestions that may give you more uniform hardness, less rejects and less retreatment.

UNITED STATES STEEL COMPANY, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY
WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Comments on U·S·S Improved Heat Treatment

by Mr. R. E. Christin, Chief Metallurgist
Columbus Bolt & Forging Co., Columbus, Ohio

"Quenching is a process often neglected in heat treatment. We feel it is just as important (if not *more* important) than any other phase of heat treatment. There is a tendency to concentrate too much on the heating—and lay too much blame for failure to the heating—when proper quenching could produce the objectives desired. Heating, even in the ideal environment, can be inadequate if quenching is faulty.

"Before we installed U·S·S Improved Heat Treatment, we occasionally encountered hardness variations in the as-quenched condition. These variations were loosely attributed to either the steel, or the heating or the quenching. However, after adopting the U·S·S agitated quench process, these hardness variations were practically eliminated, obviously indicating that conventional quenching was the chief cause of the hardness variations.

"After seven years' experience with U·S·S Improved Heat Treatment, we are convinced that this method is the answer to most hardening problems."

Carilloy Steels

ELECTRIC FURNACE OR OPEN HEARTH

COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

1-933

UNITED STATES STEEL

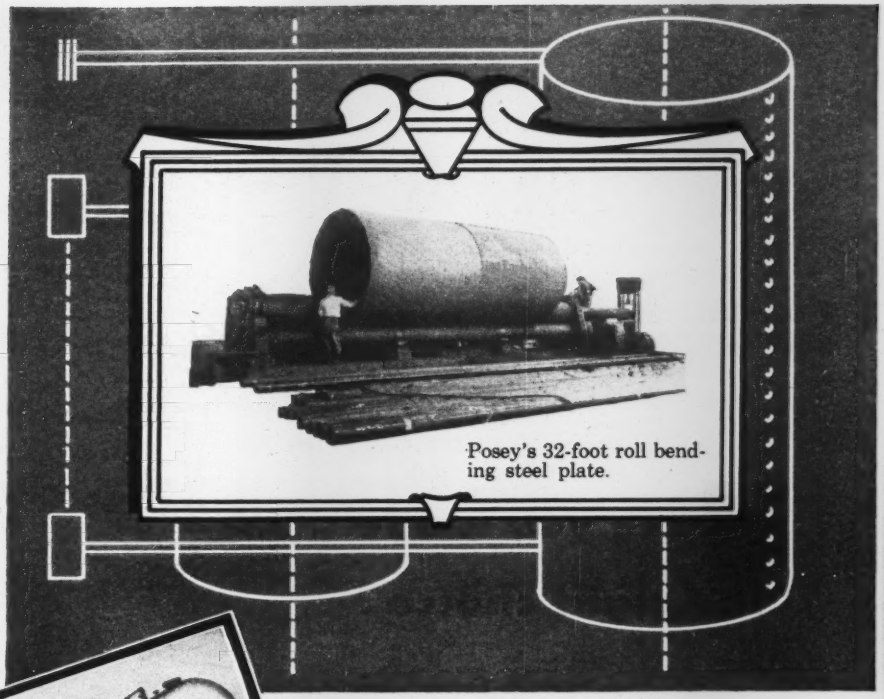
The four sources of supply and service indicated above add another Foxboro *plus value* to the advantages of these unique process control valves. Each source is equipped to assemble Stabilflo Valves in a variety of sizes and materials to meet most specific needs . . . and staffed by expert application engineers and valve specialists.

Keep the nearest source of Stabilflo Valves in the back of your mind when lining up new control valve applications or replacements. It's a Foxboro *plus value* that counts in profitable plant operation. Also get all the details on the following Stabilflo Valve features:

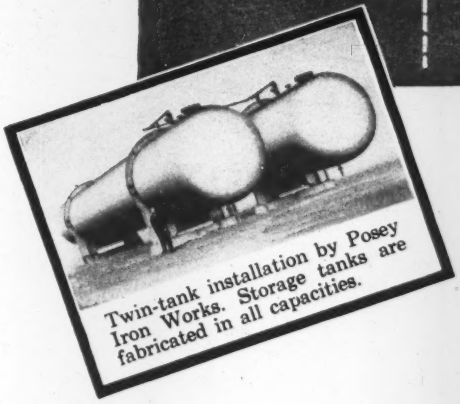
1. *50 to 1 rangeability with equal percentage flow characteristics*
2. *High lift V-Port: greater increment of lift for a given change in air pressure . . . and increased accuracy of positioning*
3. *Self-aligning, inverted-type motor — practically eliminates all sources of friction in motor action*
4. *High sensitivity of response*
5. *High force-friction ratio — negligible hysteresis*
6. *Vibration resistant*
7. *Rugged construction*
8. *Easily reversed action*
9. *Renewable seat rings*

Compare Foxboro Stabilflo Valves point for point with other valves: (1) perfect response to every impulse of the controller; (2) minimum maintenance; (3) unequalled service. Write for Bulletin 272-2. **The Foxboro Company, 1828 Neponset Avenue, Foxboro, Mass., U. S. A.** Branch offices in principal cities.

FOXBORO REG. U. S. PAT. OFF. **AUTOMATIC CONTROL VALVES**



Posey's 32-foot roll bending steel plate.



Twin-tank installation by Posey Iron Works. Storage tanks are fabricated in all capacities.

How Posey's *"Production Picture"* Fits in with Your Blueprints (and Delivery Schedules)

Today, more and more engineers are asking two questions about supply sources for steel plate construction. (1) "Have they the design experience needed to originate (or help to originate) practical blueprints?" (2) "Is their plant sufficiently adequate to assure reasonable delivery?"

Located in Lancaster, Pa.—a railroad and highway center—the plants of the Posey Iron Works cover an area of 16½ acres under roof. All have been recently modernized.

Years of *practical* experience have taught Posey engineers to study each specific application with an eye to economies and increased efficiency . . . to eliminate unnecessary steps of construction.

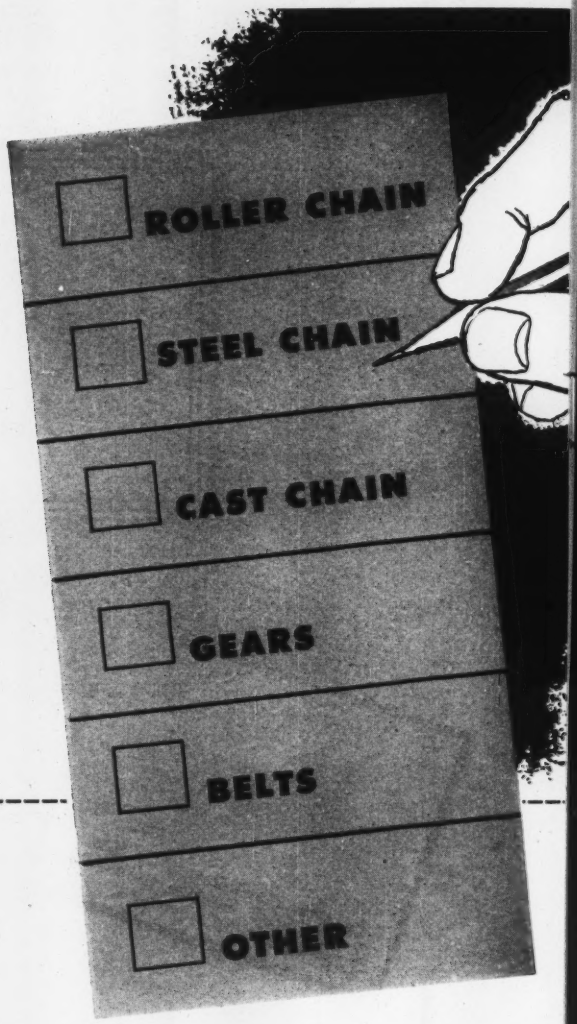
Steel plate construction deliveries unreasonably slow? Why not check with Posey?

Divisions: Brick Machinery . . . Foundry . . . Industrial Heating . . . Iroquois . . . Shipbuilding . . . Steel Plate.

POSEY IRON WORKS, INC.

STEEL PLATE DIVISION LANCASTER, PA.

GENERAL STEEL PLATE CONSTRUCTION



Have you made the right choice?

. . . if you're designing for lower cost!

Let's consider your power transmission equipment. You know that substantial savings in first cost . . . in operating cost . . . in overall cost can be realized through proper selection and application of power transmission equipment in your machines.

There is no one best method for all equipment. BUT there is a *right* answer to *each* machine for driving, timing and conveying. In the complete Chain Belt line, you can find an answer to the vast majority of applications. Because they are not handicapped by the limitations of a limited line, Rex Field Sales Engineers can help you select the exact type of chain that is right for your machines . . . for lower costs all along the line.

Perhaps you have been using a finished roller chain, yet speed and load conditions are such that a cast chain or double-pitch roller chain will operate equally well at lower initial costs.

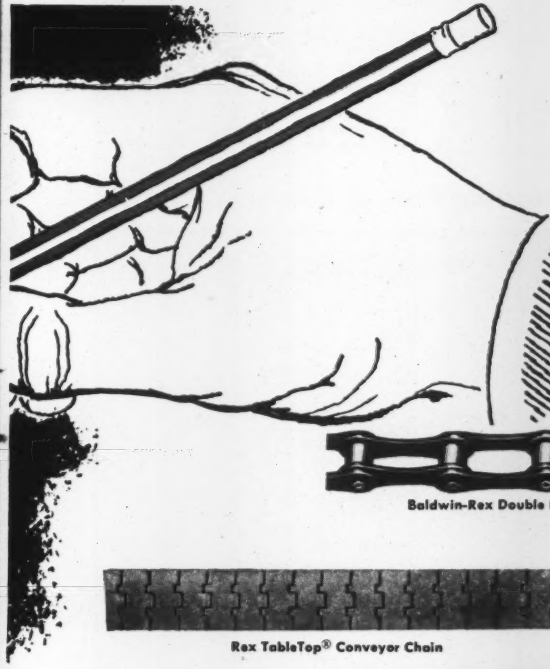
Perhaps you have been using a cast chain, yet speed requirements demand a roller chain for efficient operation. It may be that your machine demands exact timing *throughout its life.* Only finished roller chain will answer this need.

Your equipment may be required to operate in dusty, dirty conditions. Chabelco Steel Chain can save you and your customers money here.

You may be using too heavy a chain for the service conditions under which your machine is to operate. The Rex Man will help you select the right chain that will do the job effectively at lower cost.

The complete Chain Belt line provides a chain to exactly suit virtually every application. In those instances where belts or gears may be better, the Rex Field Sales Engineer can tell you why you should use these mediums for best results.

Chain Belt Company OF MILWAUKEE



Baldwin-Rex Standard Roller Chain

Rex Cast Pintle Chain

Baldwin-Rex Double Pitch Roller Chain

Rex Chabelco Steel Chain

Rex TableTop® Conveyor Chain

Baldwin-Rex Leaf Chain

Your Rex Field Sales Engineer will be happy to consult with you regarding your application problems. He may be able to help you make substantial savings. Call or write your nearest Field Sales Office. Or, if you prefer, mail the coupon.

CHAIN BELT DISTRICT SALES OFFICES

Atlanta	Dallas	Los Angeles	Pittsburgh
Birmingham	Denver	Louisville	Portland
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Gentlemen:
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Company.....*Dept*.....
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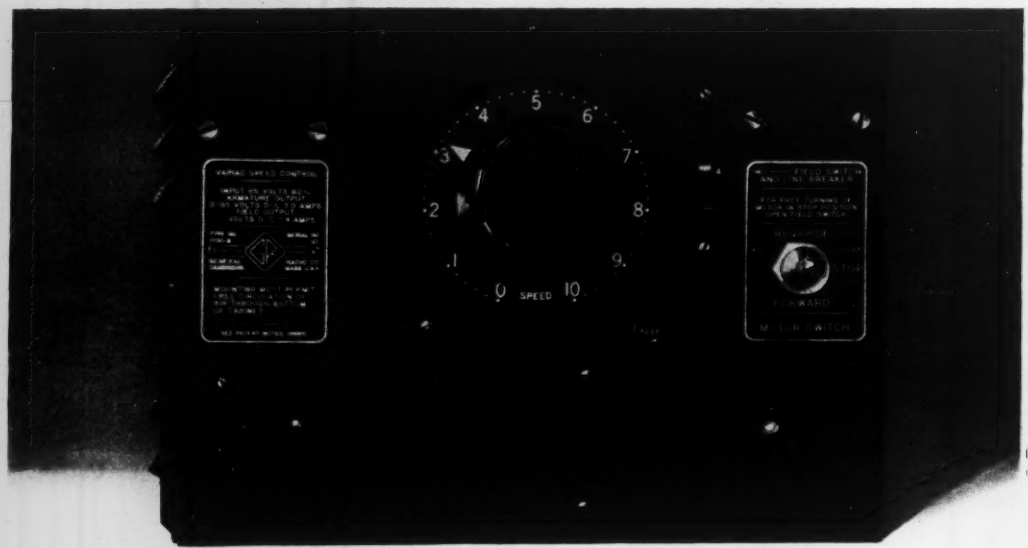
another New Variac® SPEED CONTROL

for ⅓ h.p. D-C motors operating from A-C lines



Selenium Rectifier ☆ Compact Construction ☆ Moderate Price

This new and improved VARIAC Speed Control Features:

Selenium Rectifier — *no waiting for vacuum tube to warm up — not necessary to 'idle' rectifier for instant starting — much less heat — practically indefinite life under ordinary operating conditions — at least 15,000 hours rectifier life for continuous duty in ambient temperature of 40 deg. C.*

Standard 1/3 HP Compound or Shunt Wound Motors — *either can be used — no derating required*

Instant Starting — Extra-Fast Stopping — *dynamic braking — reverse and dynamic braking require no auxiliary equipment — single "FORWARD", "STOP" and "REVERSE" switch conveniently located on control box*

Continuously-Variable Speed Range *down to zero, at constant torque*

Negligible Torque Pulsation — *armature current practically ripple free*

Excellent Regulation — *essentially that of the motor itself*

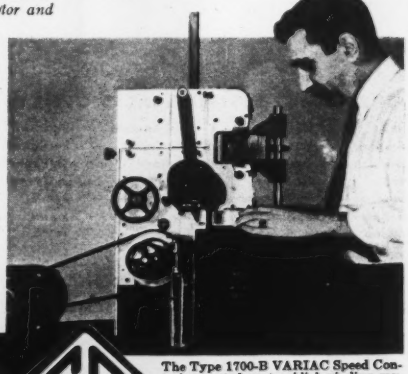
Quick Starting Under Heavy Loads — *very large short-time overload capacity — time-delay magnetic circuit breaker protects motor and control from damage from stalls*

Micro-Switches *can be used as limit devices — not necessary to break the d-c armature current*

Rugged and Compact Construction — *all control equipment and circuits in one small, rugged box — easily installed by any shop electrician — essentially maintenance free — box and control readily mounted on machine to be controlled — plug-jack connections simplify wiring — unit may be removed from box without disturbing wiring*

Type 1700-B Variac Speed Control, *105–125 v, 60 cycles* **$165.00**

Type BC46AB29 *G. E. 1/3 hp semi-enclosed 1750 rpm motor, 115 v, dc, for use with Type 1700-B VARIAC Control* **45.79**



The Type 1700-B VARIAC Speed Control mounted on toroidial winding machine. Note compactness, accessibility of speed-control knob and motor control switch.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Mass.

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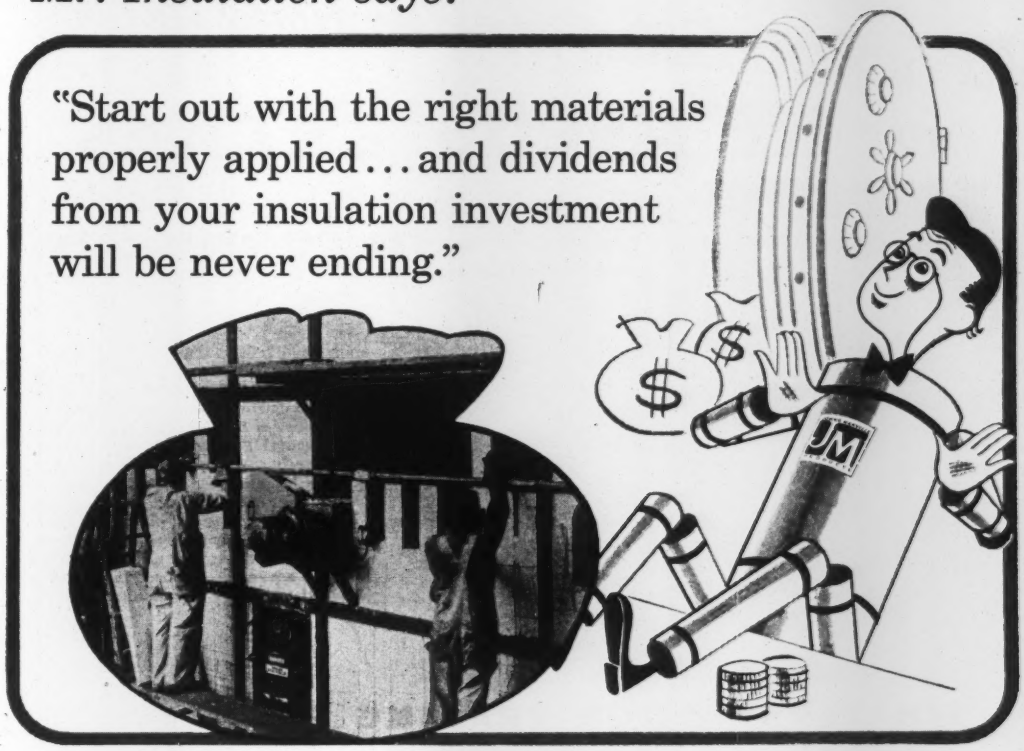
Mr. Insulation says:


"Start out with the right materials properly applied... and dividends from your insulation investment will be never ending."
$
$
JM

Here are two important reasons why it will pay you to let Johns-Manville serve as your insulation headquarters:

YOU GET THE RIGHT MATERIALS—Regardless of the service conditions on your job, Johns-Manville has an insulation that fits the need. That's because Johns-Manville manufactures a wide variety of insulations of asbestos and other selected raw materials—for service from 400F below zero to 3000F above. Johns-Manville offers this complete line because industry requires many types of insulations and because no one material can properly serve as a jack-of-all trades for use on all jobs.

YOU GET THE RIGHT APPLICATION—Insulations serve at top efficiency only when properly applied. J-M Insulation Contract Firms have men with generations of insulation experience and training in Johns-Manville application methods. The way they engineer your job is your assurance that your insulation investment will pay a high return through the years.

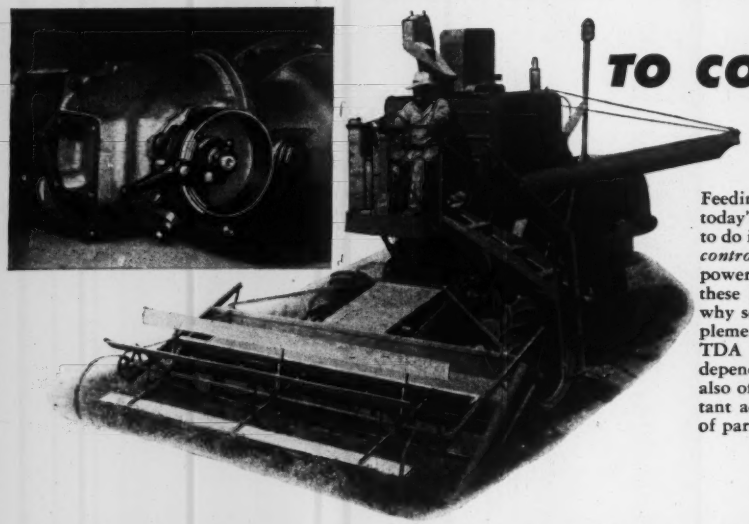
Why not call on insulation headquarters for engineering advice about your insulation work. J-M Insulation Engineers are available to help select the *right* insulation for your particular service conditions. Write Johns-Manville, Box 290, New York 16, N.Y.

JM PRODUCTS

Johns-Manville *first in* **INSULATIONS**

The Farmer's Fastest-Working "Hired Hand"!

-BUT HE NEEDS BRAKES



TO CONTROL IT!

Feeding America is a big job! And today's farmer needs modern tractors to do it! For the most part, tractors are *controlled* by brakes! It takes rugged, powerful brakes to steer, stop and hold these hard-working machines. That's why so many leading tractor and implement manufacturers standardize on TDA Brakes. Well-known for safe, dependable operation, TDA Brakes also offer the tractor user such important advantages as ready accessibility of parts and ease of maintenance.

WHATEVER *YOUR* BRAKING PROBLEM— TAKE IT TO TDA BRAKE DIVISION!

It's hard to name a machine in industry or commerce that doesn't have rotating parts! And *useful* rotation is *controlled* rotation! In most instances, that's a job for brakes—strong, dependable *TDA Brakes!* These advance-designed brakes are the result of TDA's more than 40 years of braking experience combined with the skill and know-how of highly competent technicians and engineers. If you have a braking problem—regardless of its nature and scope—contact TDA Brake Division! They'll be glad to analyze your brake needs and supply equipment precisely engineered for your specific purposes. Simply mail the coupon below!

Here Are A Few Of The Many Products Which Can Be Equipped With TDA Brakes

Centrifuges • Compressors • Conveyors • Cranes Cream separators • Diesel hook-ups • Dry cleaning machinery • Extractors • Hoists • Industrial electric trucks • Lathes (automatic) • Looms (textile) • Lumber mill machinery • Machine tools • Materials handling equipment • Motors • Packaging machinery • Paint mixers • Press brakes • Printing presses • Rolling mills • Shears • Warpers (textile) • Welding positioners • Winches • Automotive • Farm equipment Earth moving equipment • Construction equipment Public transportation

IF IT ROTATES WE CAN BRAKE IT

TDA BRAKE DIVISION—DEPT. D-5
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Please mail brake information on these applications:

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TDA BRAKE DIVISION
THE TIMKEN-DETROIT AXLE COMPANY
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The Accepted TDA Standard

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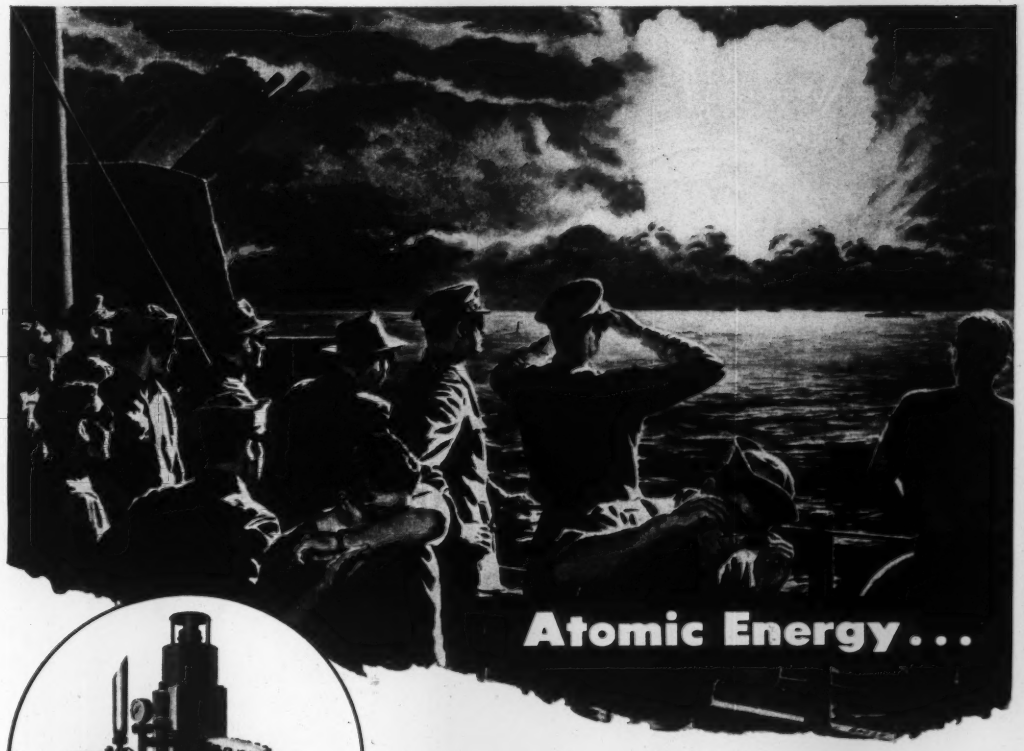
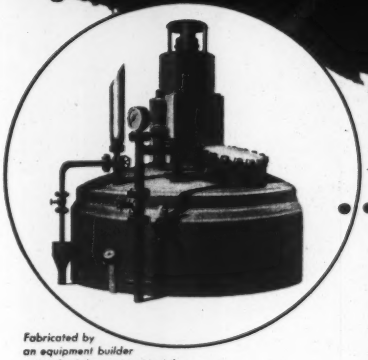


Atomic Energy...



Fabricated by an equipment builder using the Lukenomics principle.

...or Medicine

Here's a sample of Lukenomics coordination at work. For high purity in Chloromycetin—vital new antibiotic—acid adjustment tanks and fermentation units were built of Lukens Inconel Clad Steel with specially polished interiors. *Bonus* results: low initial cost, minimum maintenance, special resistance to corrosion threats of salt and other chemicals. And—by use of *clad*—the builder also saved critical amounts of one of today's scarce metals.

. . . whatever your business, if it depends on a production or process operation, consider this: *in the current emergency, how long can you keep on producing?* Here's an idea that may help.

There are progressive *equipment builders* who specialize today in delivering new production potentials despite current shortages. Coordination of the major factors in equipment design, including problem exploration, is the key.

This coordination of effort we call Lukenomics. Through it, such equipment builders combine their specialized experience, and that of competent designers and engineers, with Lukens' knowledge of materials, their production and use.

We can put you in touch with such builders. Write today, outlining your problem. Manager, Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pa.

Promote steel production generally—speed sale of your scrap.

LUKENS

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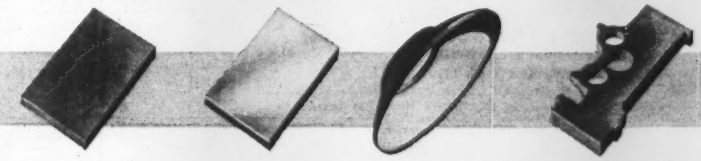
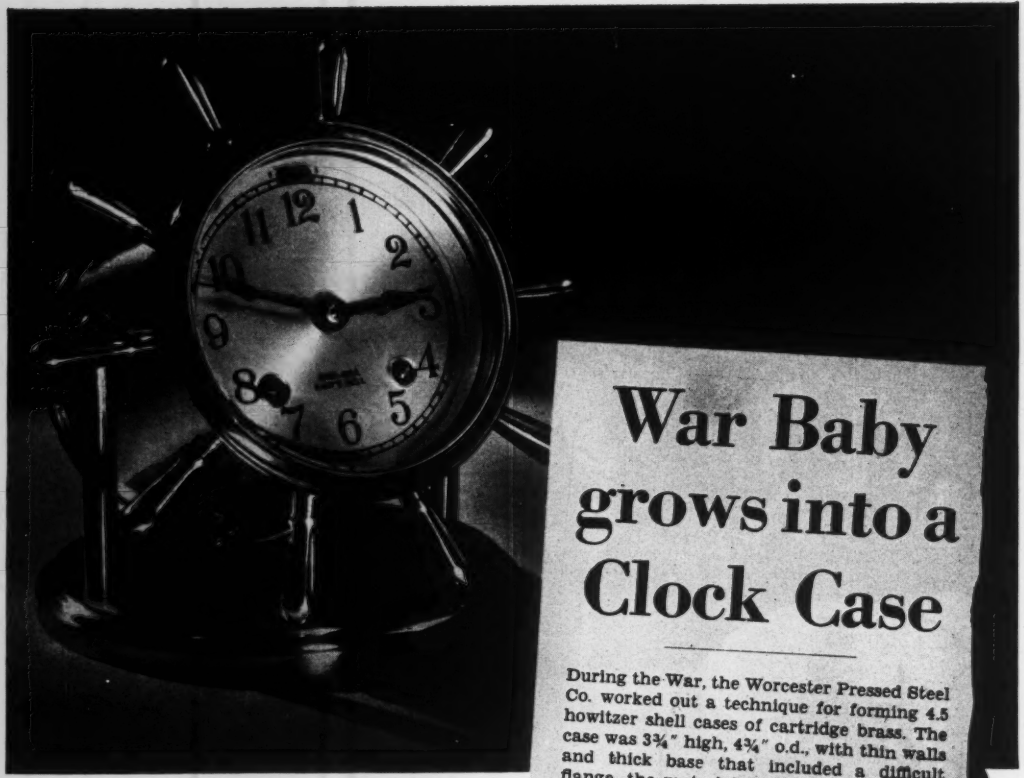
OVER 140 YEARS' EXPERIENCE AS THE WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PRODUCTS

STEEL PLATE | CLAD STEELS | HEADS | STEEL PLATE SHAPES





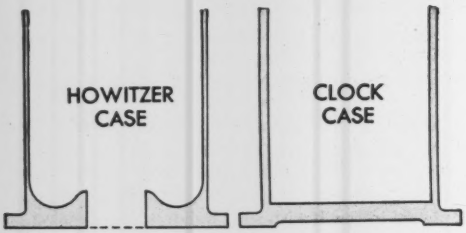
Chelsea Ship's Bell Clock, The Vanderbilt model, made by Chelsea Clock Co., Chelsea 50, Mass. Case drawn in one piece out of commercial brass by Worcester Pressed Steel Co., Worcester 6, Mass.

War Baby grows into a Clock Case

During the War, the Worcester Pressed Steel Co. worked out a technique for forming 4.5 howitzer shell cases of cartridge brass. The case was 3¾" high, 4¾" o.d., with thin walls and thick base that included a difficult flange, the material for which had to flow entirely from the base of the cup. The successful solution of the many problems required careful tool design, plus skilled control of each operation.

Later the Chelsea Clock Co. asked Worcester if it could cold-form clock cases out of commercial brass. A study of the clock case revealed striking similarities between it and the howitzer case, but on the other hand there was one important difference. The large radius on the inside of the howitzer case was not permissible in the clock case, because of the space required for the works. It was found that the bottom design could be achieved by squaring the case to the exact height, providing the bottom knockout with exactly the correct amount of spring tension in the restrike, and carefully governing the pressure and speed of press travel. The complete coordination of these factors resulted in a perfect case, and another example of the adaptation of war-learned skills to peace-time products.

• If you have problems in connection with the fabrication of copper and its alloys, or aluminum alloys, remember that the Revere Technical Advisory Service often can be helpful.



Cross sections showing similarities and differences between the howitzer case and the clock case.

REVERE 150th YEAR OF SERVICE TO AMERICA
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.
• • •
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere
SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Cooper-Bessemer Corp. Calls Kodagraph Autopositive Paper

Low-Cost Insurance against costly shop errors

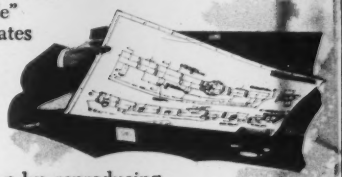
● Cooper-Bessemer, leading manufacturer of engines and compressors located in Mt. Vernon, Ohio, must supply its branch factory with intermediates (print-making masters) of home-office drawings.

But they realize that poor intermediates—like poor tracings—often produce illegible shop prints . . . which, in turn, can lead to costly errors on the production line.

It doesn't pay to take chances when thousands of dollars are at stake. Therefore, Cooper-Bessemer makes intermediates on Kodagraph Autopositive Paper, which reproduces original detail as dense photographic black lines on a clean, evenly translucent paper base.

These intermediates assure highly legible shop prints at Cooper-Bessemer's branch plant in Grove City, Pa. Even after hundreds of machine feed-throughs, Autopositives produce sharp, clean prints which are easy to read. And there's another advantage—print production is simplified, for Autopositives can be run at uniform, practical machine speeds—without frequent adjustments.

Photo-lasting in the files. The original drawings are 200 miles away, but Cooper-Bessemer's Grove City plant has full confidence in its 100% "Autopositive File"—no worries about intermediates fading, becoming brittle, or otherwise deteriorating. *Another important "extra."*



Extending Use of Autopositive. The assembly lines at Cooper-Bessemer's home plant are also seeing shop prints produced from Autopositives—will soon see many more. Plans are under way to protect some 50,000 valuable originals against the wear and tear of print-making by reproducing them on low-cost "Autopositive." The same production routine currently employed will be followed: *exposure* in a direct-process machine; *development* in standard photographic solutions.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

- **It enables you, or your blueprinter, to produce positive photographic intermediates directly at a new low cost. No negative step—ever!**
- **It enables you to protect valuable originals from wear and tear.**
- **It gives you photo-lasting file copies.**
- **It restores old, worn drawings . . . reproduces opaques.**

MAIL COUPON FOR FREE BOOKLET

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, N. Y. 16

Gentlemen: Please send me a copy of your illustrated booklet giving all the facts on Kodagraph Autopositive Paper.

Name_____ Position_____
(please print)

Company_____

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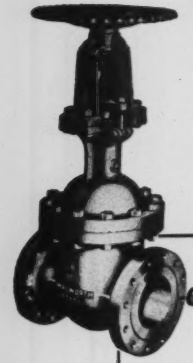
Kodak
TRADE-MARK

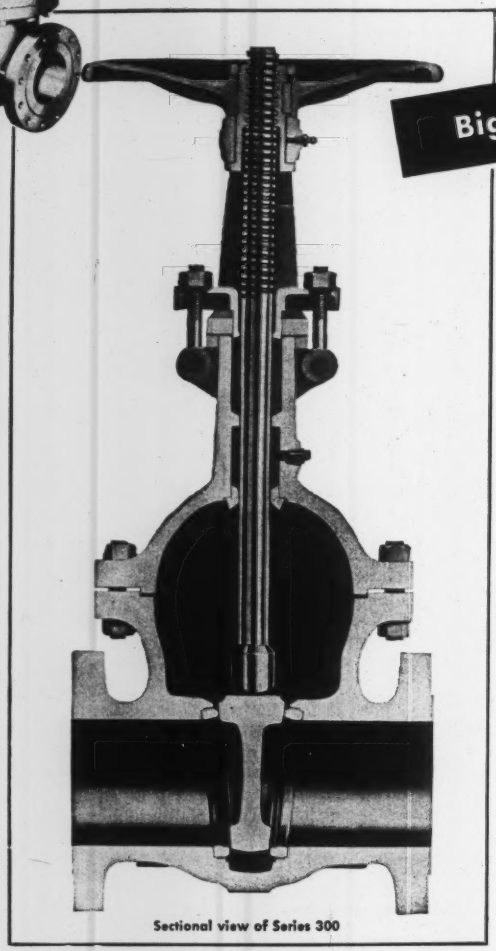
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

VARIETY

is not the spice of life here but it

Permits Piping Improvement

Midwest offers a large variety of welding fittings to help *you* improve *your* piping. Many of these fittings were originated by Midwest for the purpose.

For example, the Midwest Reducing Elbow saves a third of the welding, decreases turbulence and pressure drop and improves appearance when used instead of a standard elbow and reducer. Midwest Long Tangent Elbows have a tangent or straight section at each end equal to ¼ the nominal pipe size; this saves pipe, saves time in lining up, and often saves welding. (These are in addition to ASA Type and Short Radius Elbows.) Midwest Sleeves relieve the line butt weld of all bending stress and much of the tensile stress. Midwest Saddles restore the original pipe strength and reinforce the joint.

Use of Midwest Welding Fittings assures maximum improvement and economy in piping. For your welding fitting needs, get in touch with the Midwest Distributor near you.

MIDWEST

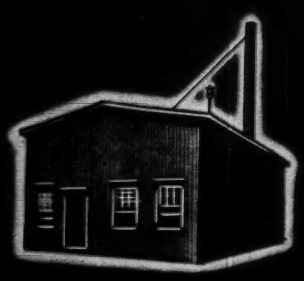
PIPING & SUPPLY COMPANY, Inc.

MAIN OFFICES: 1450 SO. SECOND STREET, ST. LOUIS 4, MO.

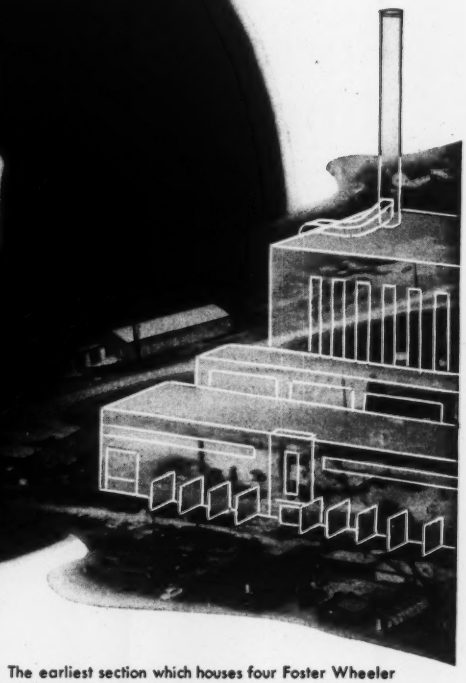
Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

MIDWEST WELDING FITTINGS Improve Piping Designs and Reduce Costs

vision – with a past,



The original Sunbury Steam-Electric Station which was built by Thomas A. Edison in 1883.

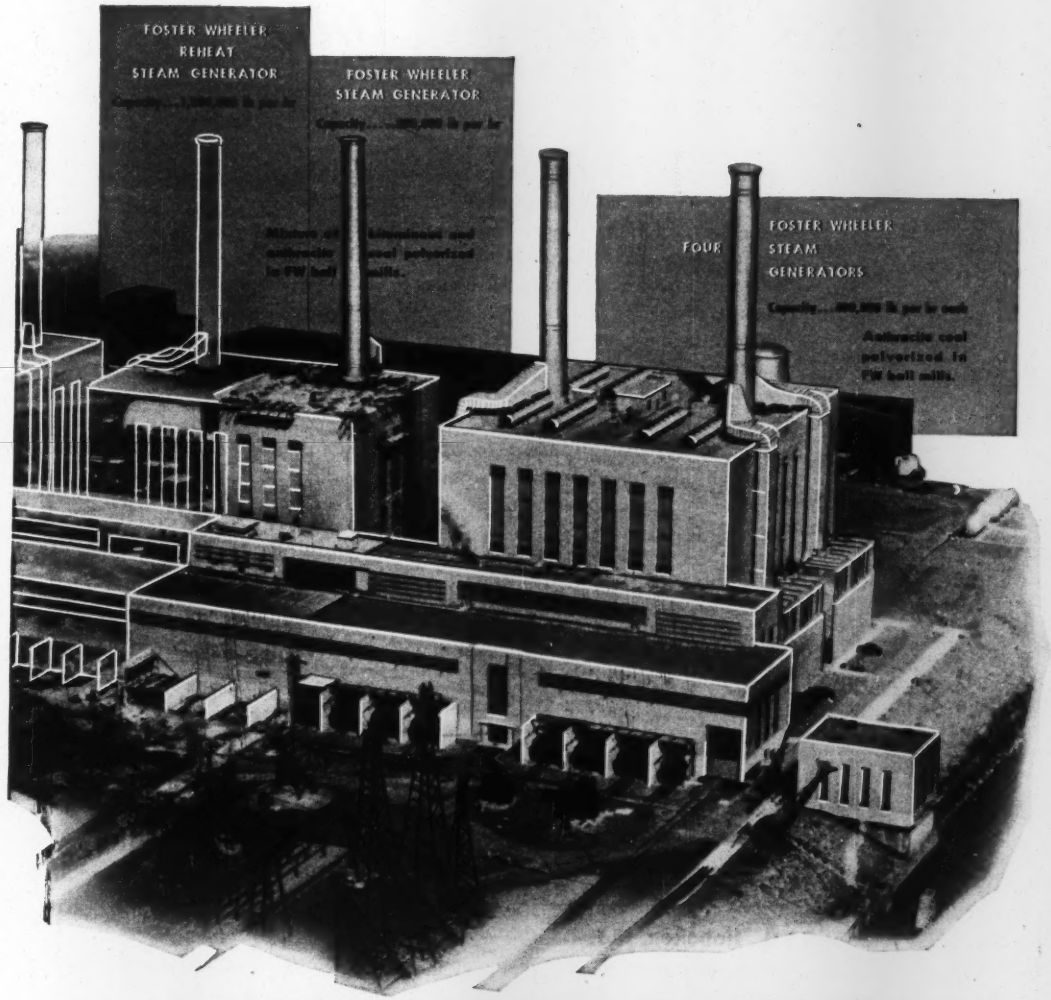


The vision began to take form on Independence Day, July 4, 1883 at Sunbury, Pa. when Thomas A. Edison threw the switch of the first commercial steam-electric station in the world. This was one of the epochal events foreshadowing the scientific, industrial, and economic miracles of the 20th century. The new Sunbury Steam-Electric Station near Sunbury, Pa. reflects both the tradition of our American past and the hope of tomorrow as its fine buildings emerge from the blueprint stage to provide an abundant source of power for factories, offices, farms, and homes in Central Eastern Pennsylvania.

The earliest section which houses four Foster Wheeler 400,000 lb per hr steam generators providing steam for two 75,000 kw turbine generators is the world's largest power plant burning pulverized anthracite. The first extension houses a 100,000 kw turbine generator and an 800,000 lb per hr Foster Wheeler steam generator. Engineering is under way for the installation of an additional Foster Wheeler 1,000,000 lb per hr reheat steam generator designed to serve a 125,000 kw unit. When ultimately completed, the station is expected to have a capacity of more than 700,000 kw.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW

present, and future



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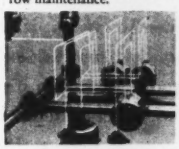

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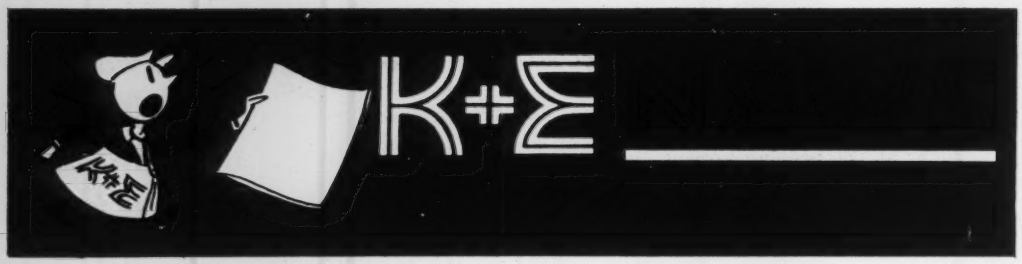

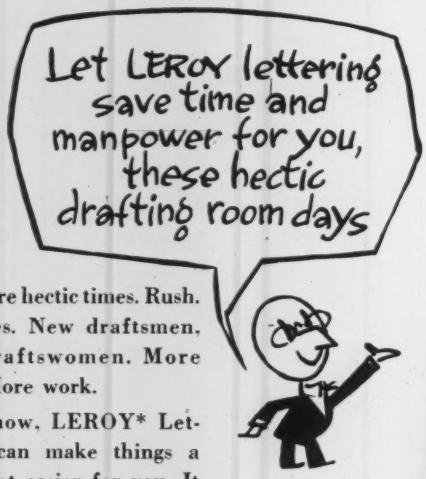

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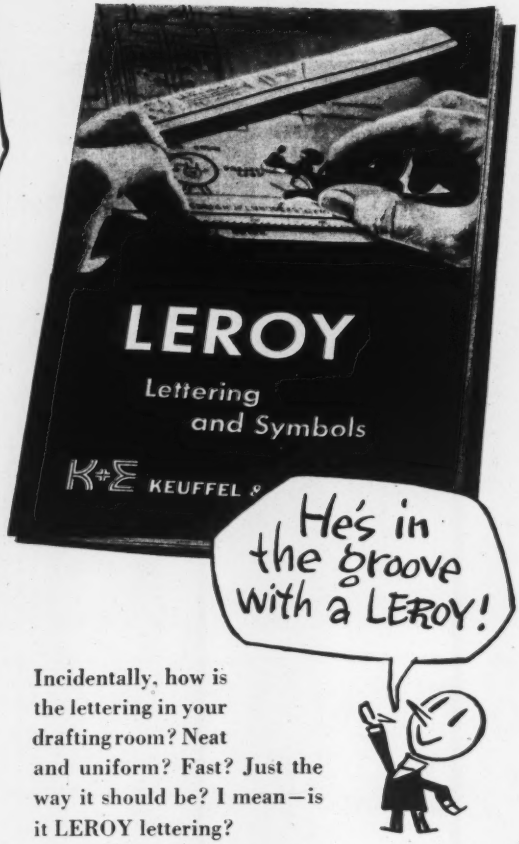

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RUGGED

RIGHT ANGLE OR VERTICAL DRIVES

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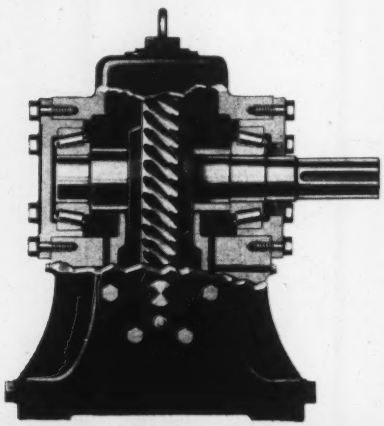
Single and Double Reductions are available in Horizontal Right Angle type with output shaft either above or below the worm shaft. Also, these units are available for vertical drives with output shaft extended either up or down. Reduction ratios range from 7⅛ to 60 : 1 and horsepowers from .081 to 262.89.



Write for Catalog WR-51. Please use your Business Letterhead.

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This test driver reports his tank in need of a moisture-proof seal.

Spongex cellular rubber will do the trick and keep *doing* the trick after endlessly repeated slammings... after oil has failed to soften it and temperatures fluctuating over a wide range have failed to stiffen it.

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It will meet Federal Specifications MIL-C-3133 & MIL-R-6130.

This tank might even be lined with *Spongex Plastic*, expanded polyvinyl chloride yielding outstanding insulation value (0.20 to 0.25 K factor) and possessing excellent crash pad properties. Also oil and fire resistant.

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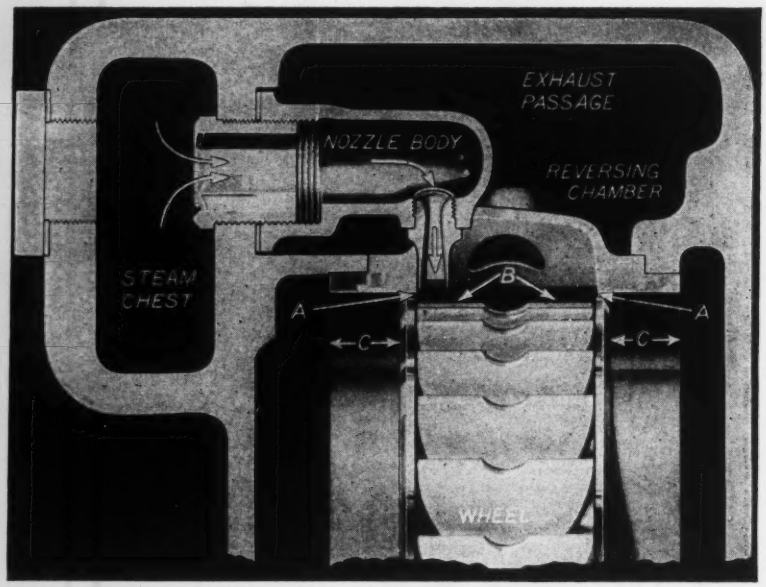


AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

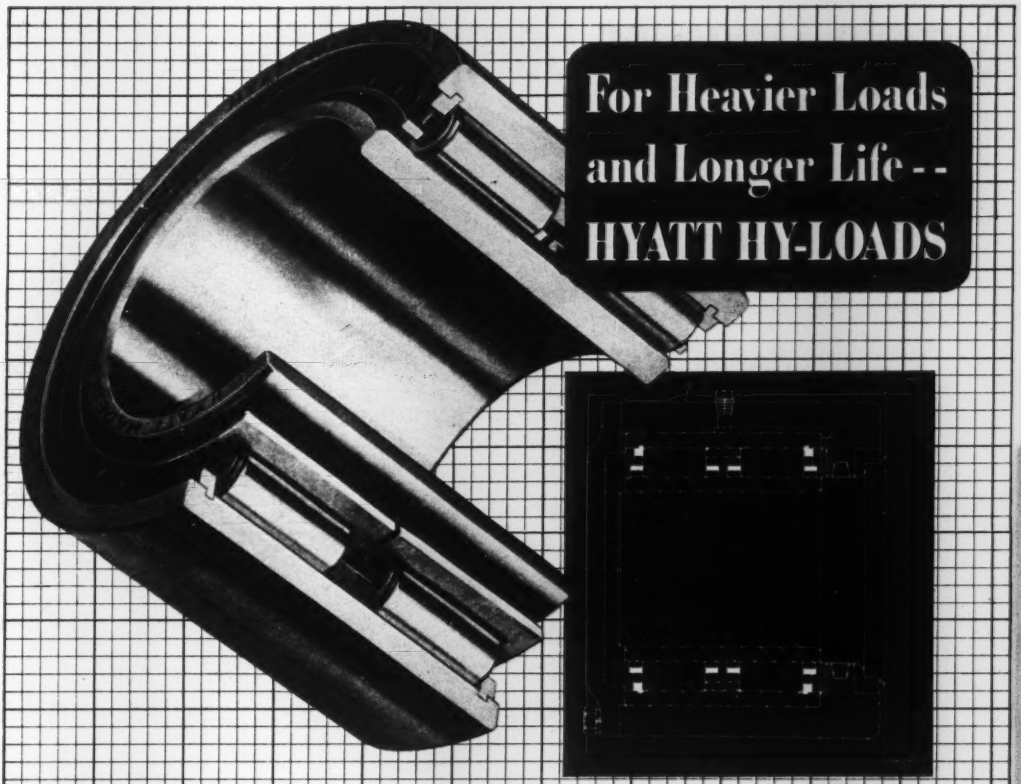
The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



For Heavier Loads and Longer Life -- HYATT HY-LOADS

The cut-away Hyatt Hy-Load Roller Bearing illustrated is the A-TS Duplex Type, 6200 Series. Duplex type Hy-Load bearings are much wider and have much greater load capacity than other standard series bearings of the same bore size. Two roller-separator sets are assembled with the outer race as a unit. The roller sets are spaced by a steel ring centered in the bore of the outer race.

While Duplex Bearings can sustain extremely heavy loads, the allowable deflection of the shaft is usually a limiting factor. The extra capacity is therefore utilized, in most cases, to meet a greater life requirement.

The straight, separable inner race type of construction makes possible simple methods of assembling machine parts and most efficient lubrication sealing. It also allows axial expansion or slight oscillation without cramping the roller ends.

The separable parts are freely interchangeable as any inner race will fit any roller assembly of the same number. The inner race can be omitted and the rollers operated directly upon a hardened and ground shaft.

The drawing shown above is a conventional bearing arrangement for a long shaft or roll and illustrates the application of a 6200 series bearing. All Hyatt Hy-Load Bearings are shown in our new Hy-Load Bearing Catalog, number 547. Write for your copy today. Hyatt Bearings Division, General Motors Corporation, Harrison N. J.

HYATT ROLLER BEARINGS

Simple Drive or Complex Transmission

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CHAIN DRIVES
Provide Positive Power—Long Life!

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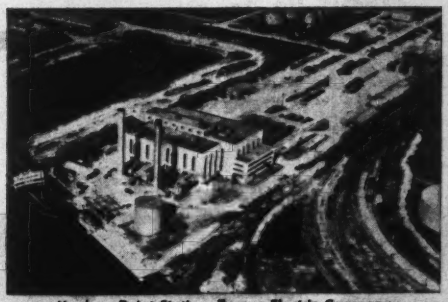
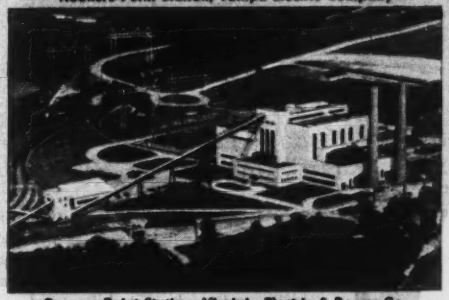
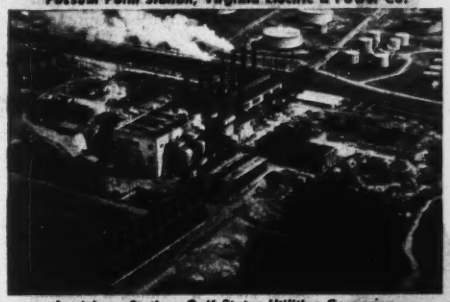


Hookers Point Station, Tampa Electric Company

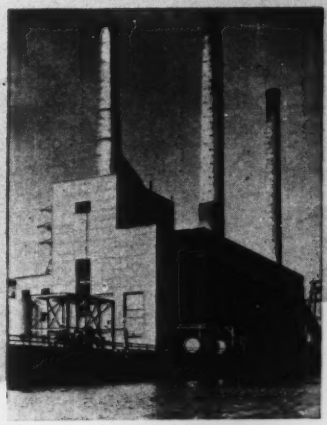


Possum Point Station, Virginia Electric & Power Co.



Louisiana Station, Gulf States Utilities Company

Venice No. 2 Plant, Union Electric Power Company



Riverside Station,
Savannah Electric & Power Company

Designed & Constructed
by
Stone & Webster
Engineering Corporation
and using

OIC Valves are *precision engineered* and *precision built*. OIC engineers offer you *precision application* help.

THE OHIO INJECTOR COMPANY
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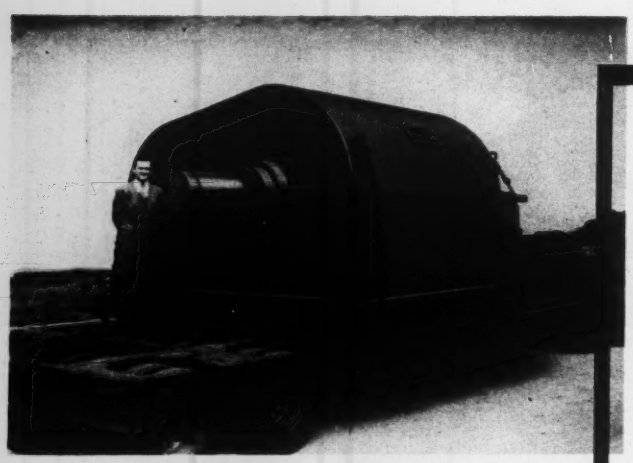
VALVES

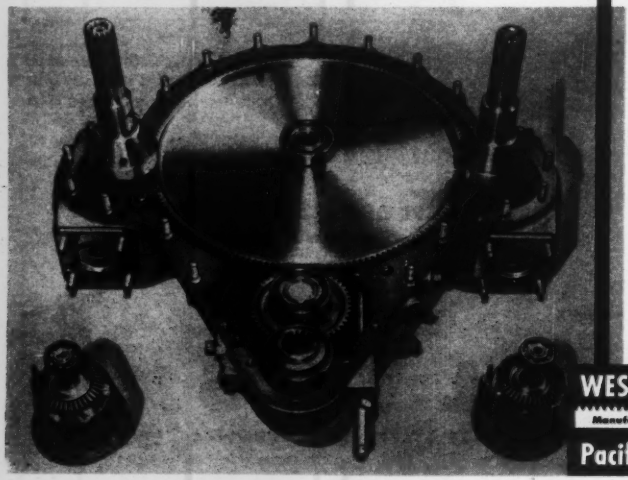
FORGED AND CAST STEEL • IRON • BRONZE



Here is an example of a large, special Pacific-Western transmission used for driving a dredge cutter head It weighs 75,000 pounds, is rated 1000 HP at 600 rpm input speed—with overload relays for operation up to 3000 HP. It operates at angles as much as 50 degrees off horizontal, partially submerged if necessary. The case is a weldment. The input gearing is herringbone, the output gearing is helical

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

In contrast to the dredge cutter drive is this precision-quality, air borne auxiliary, power-unit drive for an experimental project developed by Solar Aircraft Company. Powered by two gas turbines, the gear box drives an alternator, an exciter and six accessory pads. Input speed is 24,000 rpm, output speeds range from 3000 to 24,000 rpm Its starting-motor clutches allow the use of either or both turbines, and enables starting either turbine from the electric starter The gear train consists of highly loaded, hardened, alloy steel spur and bevel gears mounted on anti-friction bearings.



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5133

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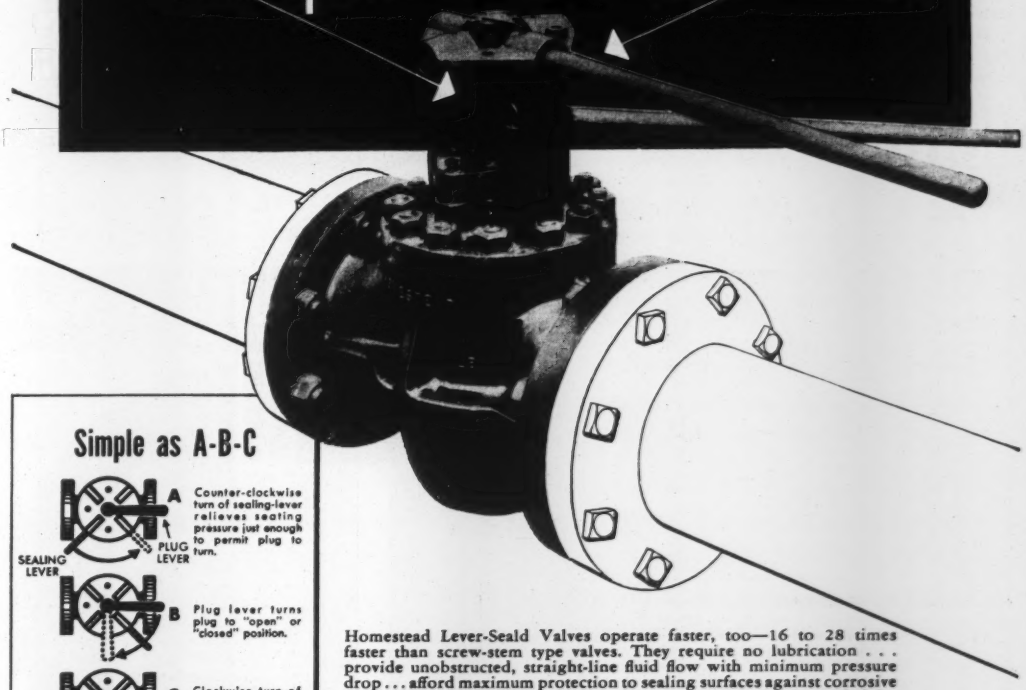
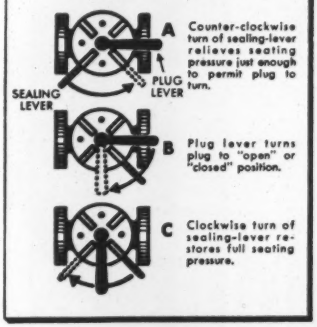
- throughout its long lifetime of service

This Homestead Valve will always work

it's **stickproof** because it's **lever-seald**



Simple as A-B-C


A
Counter-clockwise turn of sealing-lever relieves seating pressure just enough to permit plug to turn.
PLUG LEVER
SEALING LEVER
B
Plug lever turns plug to "open" or "closed" position.
C
Clockwise turn of sealing-lever restores full seating pressure.

Homestead Lever-Seald Valves operate faster, too—16 to 28 times faster than screw-stem type valves. They require no lubrication . . . provide unobstructed, straight-line fluid flow with minimum pressure drop . . . afford maximum protection to sealing surfaces against corrosive and erosive line fluids. And because only a quarter-turn is needed for full opening or closing, they are ideal for installation in restricted areas where operation of other types of valves might be difficult.

Next time you have damaged or sticking valves, replace them with Homestead Lever-Seald Plug Valves. Once you use them you'll never be satisfied with ordinary valves.

For complete information write for Valve Reference Book No. 39-3.

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HOMESTEAD VALVE MANUFACTURING COMPANY

Serving since 1892

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. . . are built in single, double and triple reduction types. Symmetrical gear arrangement provides balanced loads on liberally proportioned bearings. Housings are substantially constructed, well ribbed and have generous pads for foot bolts.

The method of selecting these reducers with complete horsepower and dimension tables is shown in Catalog 70.

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Cast Iron Pulleys • Cut Gears • V-Belt Sheaves
Anti-Friction Pillow Blocks • Flexible Couplings

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July, 1951 CARD INDEX Vol. 73, No. 7

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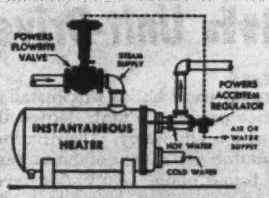

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Compressed air or water operated

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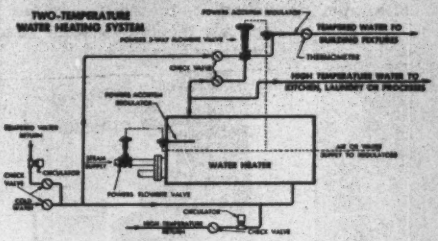

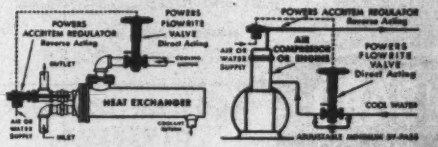

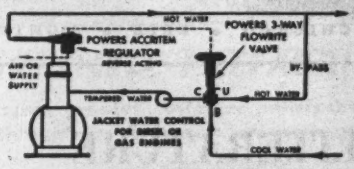

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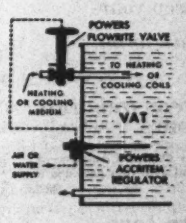

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Diaphragm Valves
controlled by a POWERS
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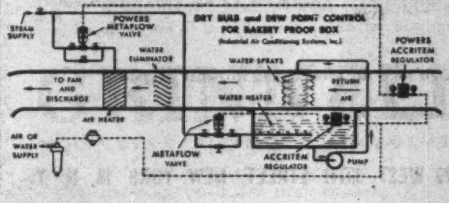

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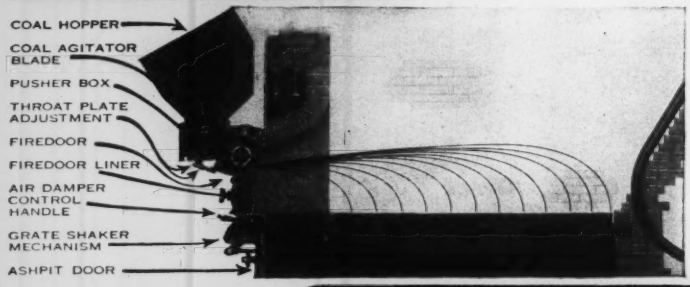

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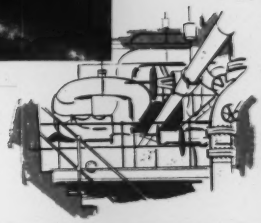

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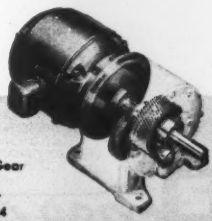

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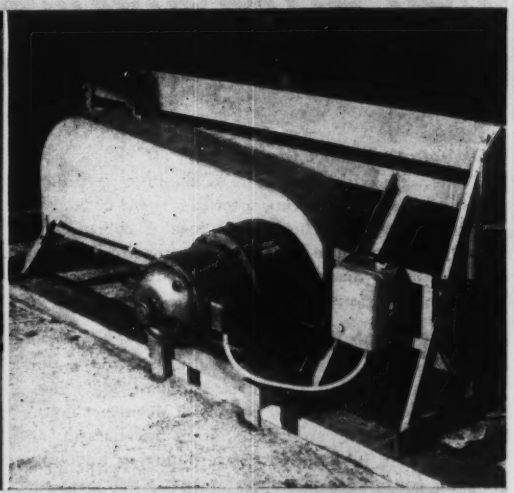

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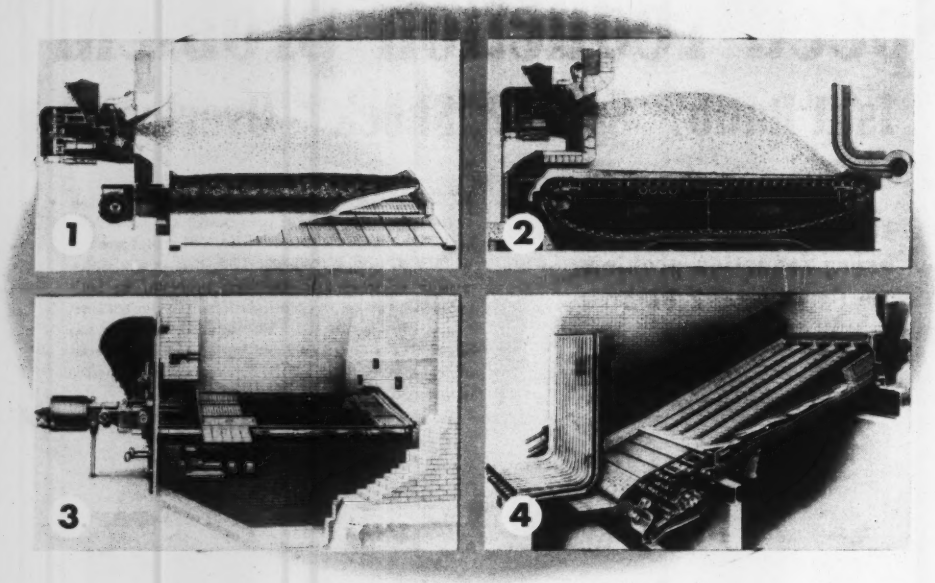

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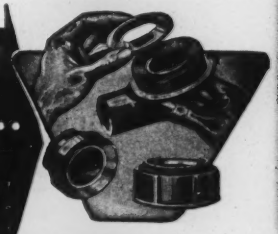

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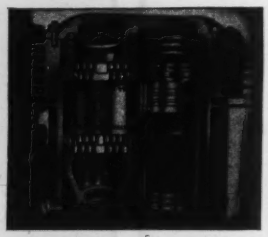

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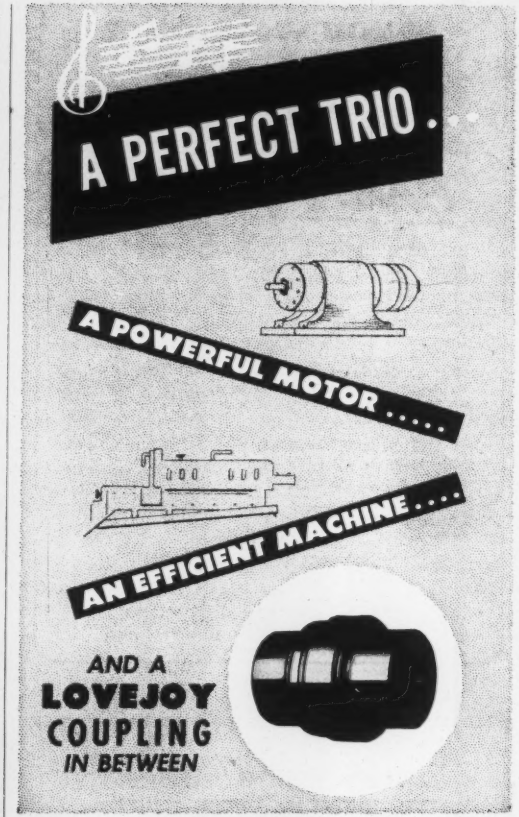

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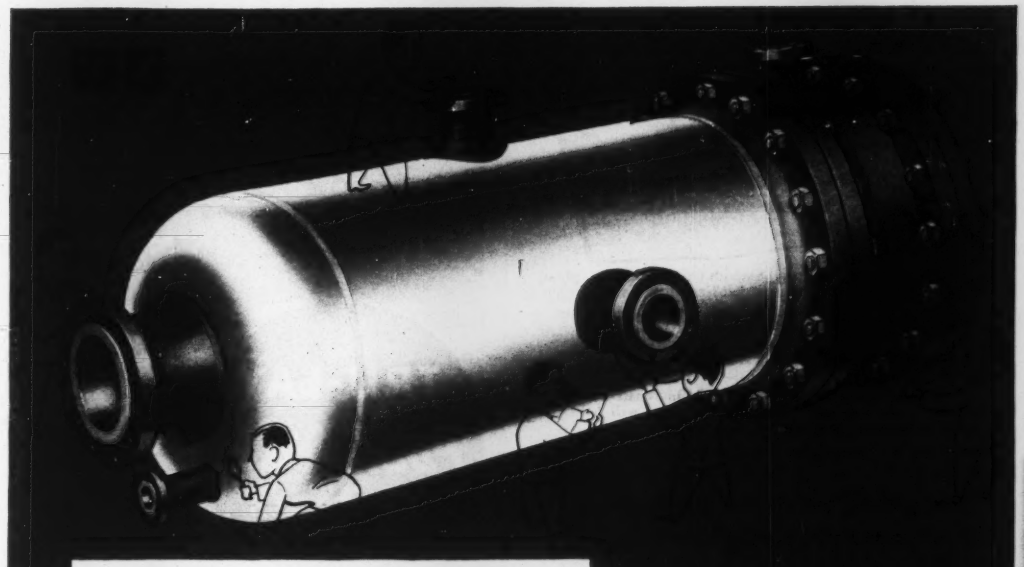

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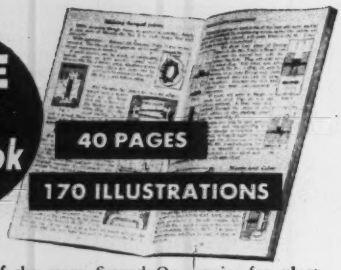

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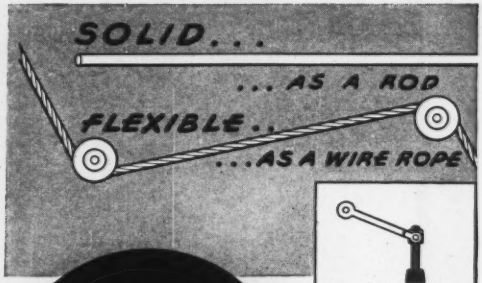

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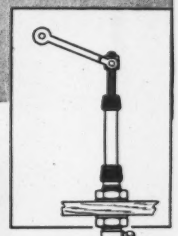

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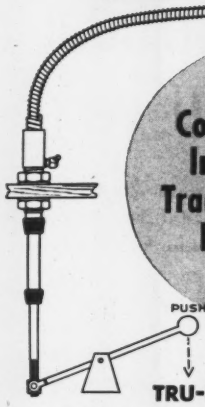

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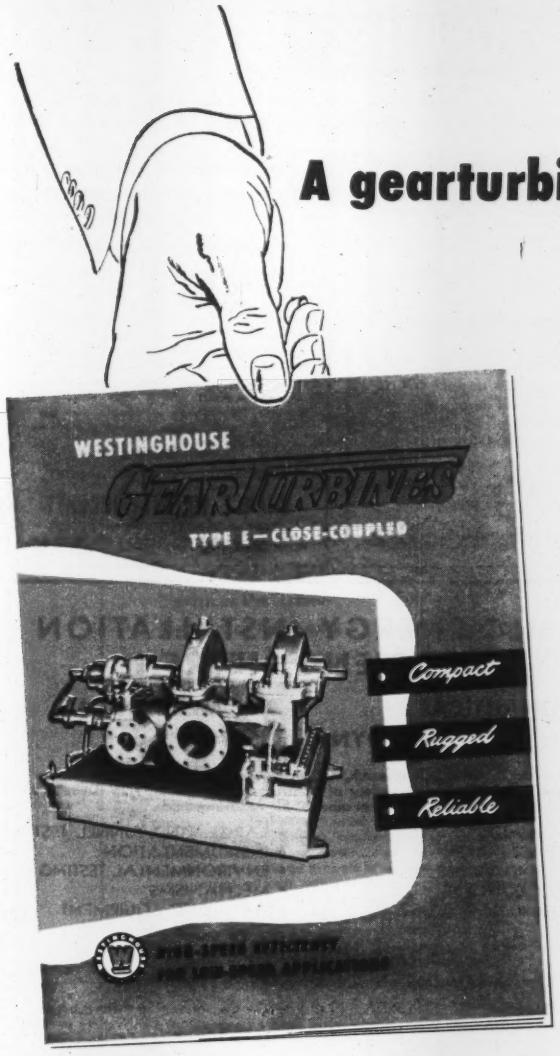

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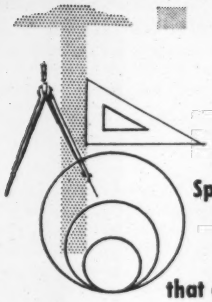

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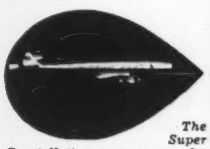

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Continued on Page 121

Eight Pages of "OPPORTUNITIES" This Month . . . 114-121

POSITIONS OPEN

Continued from Page 120

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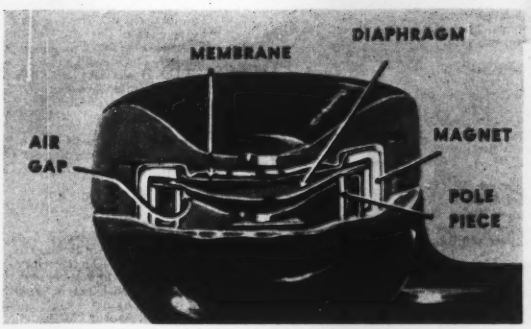
Easy on the ear



More naturally than ever, your voice comes to the ear that listens through the latest telephone receiver developed at Bell Telephone Laboratories. The reason: a new kind of diaphragm, a stiff but light plastic. Driven from its edge by a magnetic-metal ring, the diaphragm moves like a piston, producing sound over all of its area. Effective as are earlier diaphragms of magnetic-alloy sheet, the new one is better, gives more of the higher tones which add that personal touch to your voice.

To work the new receiver, telephone lines need deliver only one-third as much power. So finer wires can do the job. This is another new and important example of the way scientists at Bell Telephone Laboratories work to keep down the cost of telephone service, while the quality goes up.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE ONE OF TODAY'S GREATEST VALUES

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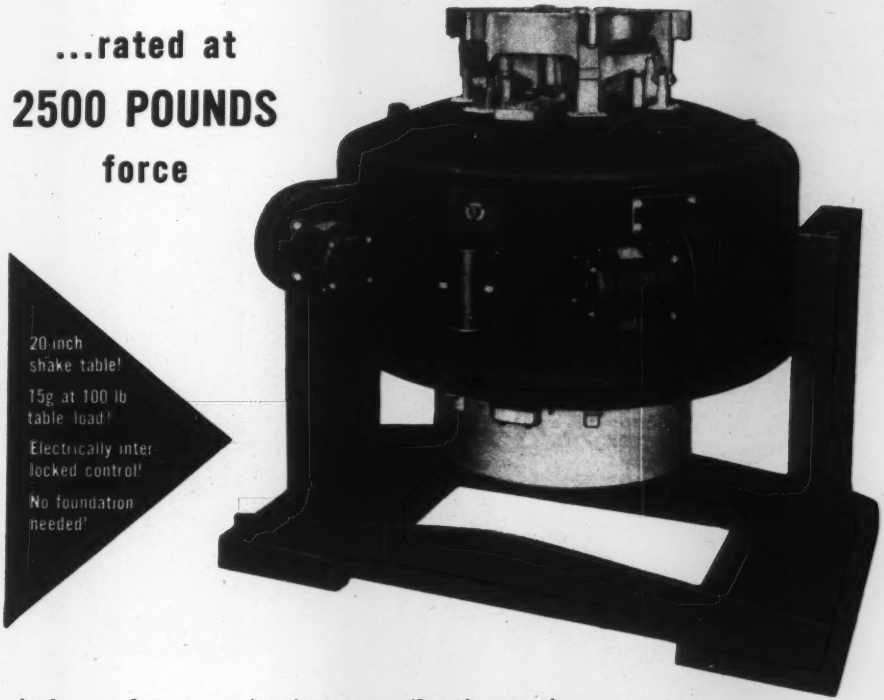
Big New MB Shaker!

...rated at

2500 POUNDS

force



Here's heavy duty capacity for your vibration testing to military specification MIL-E-5272 and 41065-B

Vibration testing reveals *in advance* how your products will behave in service. It's a "must" for military equipment. This new MB model C-25 shaker, one of the largest developed, provides large "brute force" for meeting military vibration testing specifications. Rated at 2500 pounds continuous vector force, it has capacity to produce 15g with 100 lb table load or 20g with 58 lb table load.

An electromagnetic exciter, MB model C-25 features accurate, continuous, easy control of force and frequency. Electrically interlocking controls assure proper operation.

Whether your own vibration testing requirements are of large order or small, you can get the answer to your problem at MB. Models start at 10 pounds force output. Resonant beams for special problems also available.

Make MB *your* headquarters for help and advice on vibration problems. You'll save yourself time and work. ***Write for new Bulletin No. 1-VE-4 on vibration exciters.***

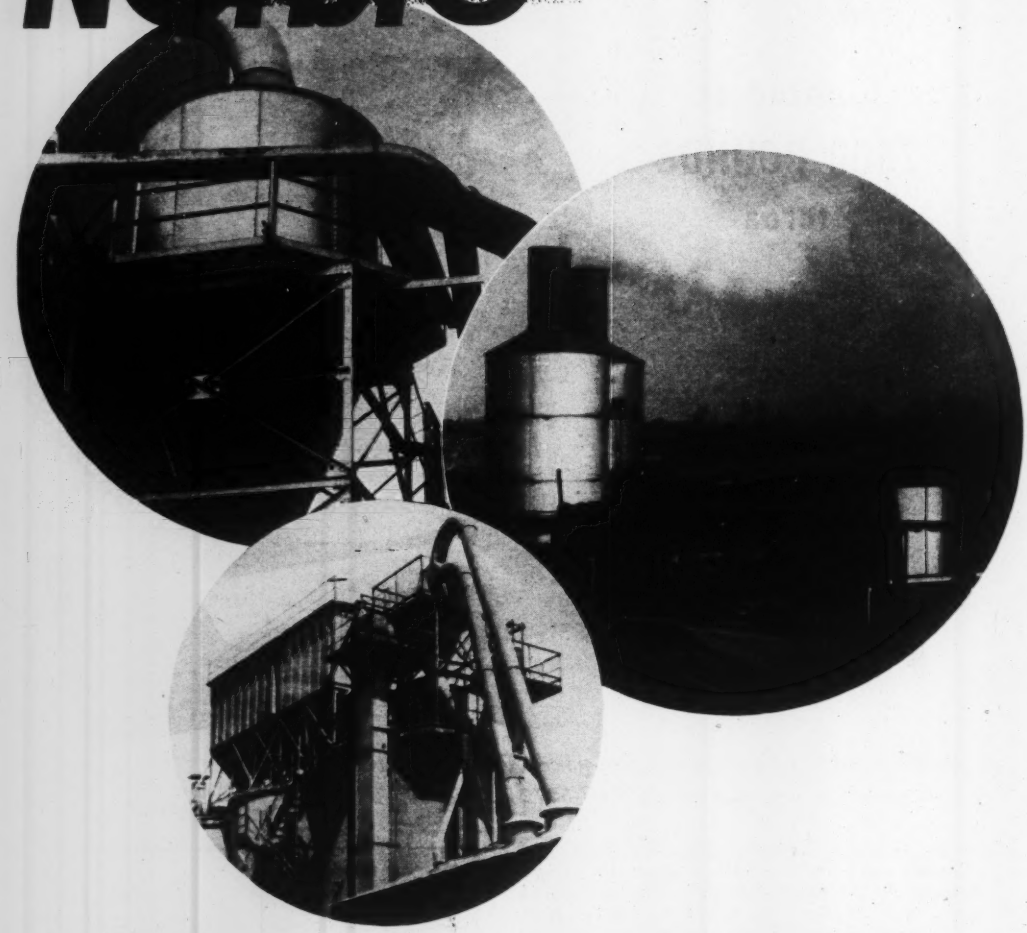
MB's C-25 shaker with control panel. Available with built-in meter to read directly acceleration, velocity or displacement.

THE MB MANUFACTURING COMPANY, Inc.

1060 STATE STREET, NEW HAVEN 11, CONN.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION...TO MEASURE IT...TO REPRODUCE IT

Norblo



Equipment for Better Dust and Fume Collection

Norblo dust collection equipment includes the three distinct types shown above—centrifugal, hydraulic, and bag type. While each type has advantages in specific conditions or applications, Norblo Automatic Bag Type is the wheelhorse for modern, large scale, heavy duty or continuous service. The largest installations of dust collection equipment in North America are fuming installations in the smelting field. Some of these move air by the millions of tons a year.

Up to the present moment no type of large scale dust or fume collecting equipment has proved itself more efficient, or lower in operating and maintenance cost in continuous large scale operation than Norblo Automatic Bag Type Dust Collectors. Get the facts.

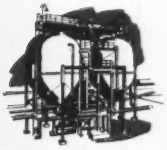
THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

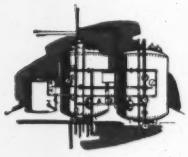
6421 BARBERTON AVE. • CLEVELAND 2, OHIO

5 WAYS TO → SOFT, CLEAR, PURE WATER

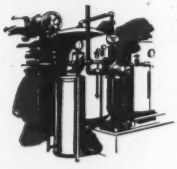
. . . for Power Plants



1. SLUDGE BLANKET HOT LIME SODA. *Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.*



2. HOT ZEOLITE—PERMUTIT Q. *Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, a styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.*



3. SILICA REMOVAL PLUS DEMINERALIZATION. *Demineralization by cold ion exchange processes produces water comparable to distilled water at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.5 ppm.*

4. DEAERATING HEATER. *The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.*

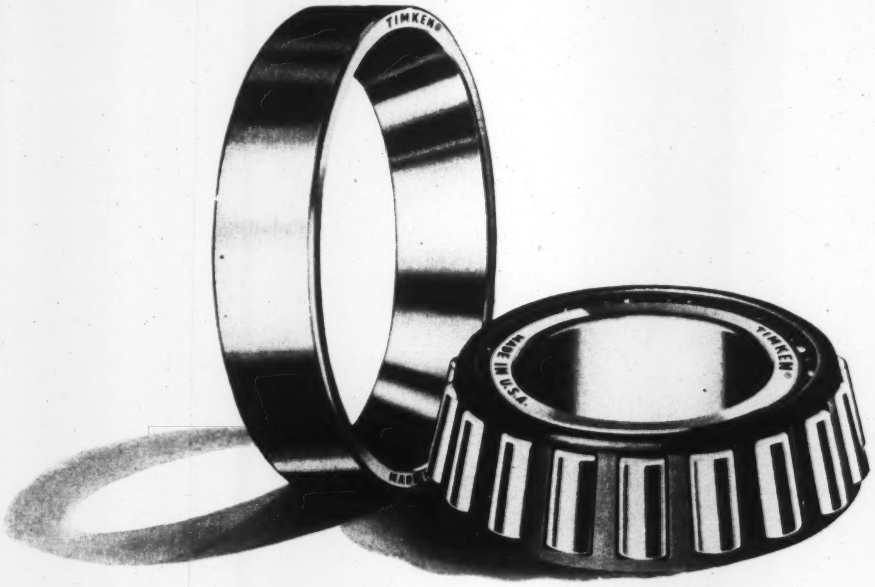
5. PRECIPITATOR. *The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.*

These basic processes, plus Permutit skill—can solve your water conditioning problem

Other processes include mixed bed demineralization and cold zeolite water softening. Whatever your problem, Permutit has equipment to solve it. Write for free information to The Permutit Company, Dept. ME8, 330 West 42nd St., New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

PERMUTIT

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS



NEW TIMKEN® DOUBLE-ZERO BEARING

Why we made this bearing so accurate that almost nobody uses it

THIS new Timken® bearing is twice as accurate as any Timken bearing previously made. It has a maximum run-out tolerance of only 75 millionths of an inch. Not many industries are using this bearing . . . yet. It is used mainly on high-speed lathe spindles, precision grinding machine work heads, gear cutting machines, precision rolling mills, and in other applications where extra-high accuracy is important.

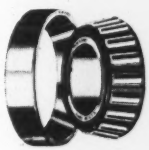
But the development of the Timken "Double-Zero" bearing is important to *every* tapered roller bearing user. Experience gained in producing the "Double-Zero" bearing is showing the way to greater and greater precision in *all* Timken tapered roller bearings. Increased precision means greater bearing capacities, permitting the use of smaller bearings at lower cost.

Just as today's standard bearing was the super precision bearing of a few years ago, the new "Double-Zero" bearing of today may well become the standard Timken bearing of tomorrow. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN

TRADE-MARK, REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ▯ AND THRUST ▭ LOADS OR ANY COMBINATION ◎